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The *Bulletin* serves as a means of communication between the Department of Defense, its authorized agencies, defense contractors and other business interests. It provides guidance to industry concerning official DOD policies, programs and projects and seeks to stimulate thought on the part of the Defense-Industry team in solving problems allied to the defense effort.

Suggestions from industry representatives concerning possible topics for future issues are welcome and should be forwarded to the Editor at the address shown below.

The *Bulletin* is distributed free of charge to qualified representatives of industry and of the Departments of Defense, Army, Navy, and Air Force. Subscription requests should be submitted on company letterhead, must indicate the title of the requester, and be addressed to: Editor, Defense Industry Bulletin, Hq., Defense Supply Agency, Alexandria, Va. 22314.

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DEPARTMENTS

A pilot and bombardier-navigator walk to the A–6A Intruder attack aircraft for an early morning launch. Naval Air Systems Command (NAVAIR) has the responsibility for development and procurement of Naval aircraft. An article on NAVAIR's program management begins on page 26.

How Do You Stack Up With Equal Employment Opportunity?

M. Robert Shafer

Achieving equality of opportunity for all citizens of our nation is one of our most serious and challenging national problems. The equality demanded must recognize the full dignity of the individual to seek and achieve his highest potential in productive employment, without regard to race, creed, color, religion, sex, or national origin. Circumvention of this right on any basis, not directly related to job performance, cannot be tolerated if we are to survive and prosper as a nation founded on the concepts of freedom and equality.

The goal of "equal employment opportunity" is a matter of national policy. In furtherance of this policy, we are committed to the concept of limiting the award of government contracts to firms which comply not only with the letter, but with the spirit of this national policy in their personnel practices.

On June 25, 1941, President Roosevelt issued an executive order forbidding employment discrimination in Government and in defense industries. A program landmark was formal implementation on March 6, 1961, with the President signing Executive Order 10925.

With the signing of this order, all government contracting agencies were required to include, in all future contracts, a provision binding government contractors to non-discriminatory personnel practices, except in specifically exempted contracts. The order was implemented by the President's Committee on Equal Employment Opportunity with compliance enforcement responsibility residing in each contracting agency. Agency jurisdiction over any specific contractor was based on dollar volume in contracts.

Executive Order 10925 was superseded on Sept. 24, 1965, by Executive Order 11246. These orders were essentially parallel except for the substitution of the Secretary of Labor for the President's Committee on Equal Employment Opportunity. As an interim measure, the Secretary of Labor announced retention of the rules and regulations of the defunct President's committee, until his newly created Office of Federal Contract Compliance was in a position to issue its own guidance.

Two months after the new executive order was signed, on Nov. 22, 1965, then Deputy Secretary of Defense Cyrus Vance announced the consolidation of compliance programs within the military departments and the defense supply agency under the Assistant Secretary of Defense for Manpower. The actual consolidation took place on July 30, 1966, and continued until July 1, 1967.

The organizational evolution, to this point, had done little to refine the compliance ground rules. It did, however, bring the program into perspective and surface the myriad problems involved in its administration. During the year of operation under the immediate direction of the Assistant Secretary of Defense for Manpower, it became increasingly apparent that a policy-making body had neither the capability nor the conceptual organization to intimately support the "grass root" problems of a nationwide compliance effort. A detailed management survey confirmed the need for organizational realignment to effectively enforce the provisions of the Equal Employment Opportunity Program. The recommendations of the survey led to the functional transfer, on July 1, 1967, of the DOD Compliance Program to the Defense Contract Administration Services (DCAS) of the Defense Supply Agency.

Thus, the present-day organization evolved for carrying out the DOD contract compliance responsibilities. Fundamental regulatory guidance flows from the Office of Federal Contract Compliance of the Department of Labor. It is translated into operational procedures by the Contract Compliance Office in DCAS. These are executed in subordinate elements within

the 11 DCAS regions covering the 50 states.

True Problems Emerge

The stage was set; the actors were in place. But it soon became apparent that the script was unclear. There were many unresolved questions.

What constitutes compliance?

The problem did not lie with contractors who were actively and openly equal opportunity employers. Nor was it difficult to isolate those who carried discrimination to the point of segregated work areas, restaurants, wash rooms, drinking fountains, parking lots, transportation and housing facilities. The crux of the problem—the real no-man's land—was in the subtle shadings, the inadvertent and often unintentional practices that are discriminatory in effect—practices that have survived through custom.

The questions to be answered were complex.

Just what does equal employment opportunity mean when superimposed on an existing industrial organization replete with intricate and far-reaching policies, practices, customs and mores that make up the corporate personality?

Where does a contractor start, and how does he achieve a posture of compliance? Once achieved, how is it maintained?

Can a contractor overcome present effect of past practices without discrimination in reverse?

By August 1968 we had refined a list of factors covering areas such as recruiting practices designed to attract minority groups, interviewing techniques which avoid bias, non-discriminatory test criteria and training programs, equality in facilities, and fair appraisal procedures. The list of factors, though circulated widely in the industrial community, was designed to assist the government compliance reviewer. Though still falling short of our goal, these factors did provide basic tools for objective evaluation.

Who Must Comply?

So far we have traced the government and DOD organization for contract compliance from the embryo state to its present design. We have considered a few of the major problems involved in assuring compliance. We have taken a brief look at our efforts to overcome these problems.

Let us now consider for a moment who must comply if they wish to deal with the Government. It may generally be said that all contractors holding government contracts in excess of $10,000 are contractually bound to effectively provide equal opportunity to all employees and potential employees. There are a few exceptions spelled out in the Armed Services Procurement Regulation.

For our purposes, a contractor is considered a government contractor whether under direct contract with the Government, or as a subcontractor at any tier. This requirement applies to all segments of the contractor's organization whether it be a single or multifacility organization, even though the contract is to be performed by a single isolated segment. This all encompassing requirement is the key—it is designed to force compliance. When the corporate entity accepts a contract, it commits the entire organization as an equal opportunity employer.

Order Number 4

Before we take a look at the implications of Order Number 4, let's see if we can't put the true meaning of equal employment opportunity in a reference context.

Equal opportunity can best be described as total consistence in all policies, procedures and actions dealing with the workforce in all job classifications throughout all levels of the corporate hierarchy. There must be no discrimination, either active or passive, with regard to race, creed, color, religion, sex, or national origin. The only exception is where an employee of a particular sex can be justified on the basis of specific job requirements.

A contractor with 50 or more employees and a contract of $50,000 or more must, in addition to compliance, develop and maintain a written affirmative action compliance program for each facility of his organization. This requirement for government contractors, outside the construction industry, was spelled out by the Department of Labor in its Order Number 4, which became effective on Jan. 30, 1970.

Order Number 4 provides clearcut and positive guidance, and even some suggested methods, for establishing an affirmative action program. These implementing guidelines are essentially patterned after those prepared in 1968 by Plans for Progress, the voluntary equal employment opportunity activity, which last year merged with the National Alliance of Businessmen. The rules of Order Number 4 are designed to carry out a July 1968 Labor Department directive requiring government contractors and subcontractors to develop written affirmative action compliance programs for each of their establishments. There remains little doubt concerning the mechanics and corporate attitude essential to effective compliance with the President's Equal Employment Opportunity Program. By virtue of its comprehensive coverage, contractors will find the going easier in implementing their own programs. Now various federal agencies, with contract compliance responsibility, have a handbook of common compliance measuring criteria.

Meaningful Application

The contractor's program must be detailed in a set of result-oriented procedures. He must then commit himself, in good faith, to exert the necessary effort to make the program successful. This combination—effort applied to meaningful procedures—is equal employment opportunity.

A prime requisite to the application of good faith effort is to determine present compliance status, and identify and correct deficiencies. There are many peripheral areas of compliance, such as poster display, the "equal opportunity employer" phrase in recruitment advertising, etc. These, while important, are only incidental to the central core of the problem—the underutilization of minorities.

The first step in a get-well program is diagnostic—a detailed analysis of the workforce composition in all major job categories. The analysis must avoid the superficial and get right down to the basic corporate structure. As an example, if the supervisory force is made up of categories such as general foreman, foreman, and assistant foreman, the analysis must treat each as a separate entity. This same approach applies to

all workforce job categories at all levels.

Order Number 4 tells us that the category-by-category analysis must, as a minimum, consider nine well defined factors which must be viewed in their broadest sense:

- Minority population of the labor area surrounding the facility.
- Degree of minority unemployment in the labor area surrounding the facility.
- Proportion of minority group members in the total work force in the immediate area.
- General availability of minorities having requisite skills in the immediate labor area.
- Availability of minorities having requisite skills in an area in which the contractor can reasonably recruit.
- Availability of minority employees who could be promoted within the contractor's organization.
- Anticipated expansion, contraction, and turnover of the workforce.
- Existence of training institutions capable of training minorities in the requisite skills.
- Degree of training which the contractor is reasonably able to undertake for making all job classes available to minorities.

Several of the factors mention "labor area surrounding the facility" or "immediate labor area." The parameters of a labor area will vary from facility to facility, and can be given dimension only when related to a particular case. Any useful generalization that can be made must be related to present workforce. If some of the regularly employed workers live a distance of 50 miles, then the parameters in both instances would be a 50-mile radius.

The seventh factor deals with workforce variations resulting from expansion, retrenchment, and turnover. Expansion and turnover provide obviously excellent vehicles for curing a problem of underutilization. The recent environment of retrenchment has been used by a few as an excuse for failure to aggressively pursue a course of affirmative action. This rationale is, at best, tenuous, unless the retrenchment is started from a point of full minority utilization at all levels of the organization. Regardless of the prevailing economic climate, a positive approach will achieve results.

The eighth and ninth factors address the availability of training in the requisite skills, and the degree to which a contractor is able to take advantage of training. Training in this context is given broad meaning, and reaches beyond the formal assemblage. Careful consideration must be given to the subtle, usually informal, quasi training programs, leading to progression through various levels of the organization. A prime example is the temporary and intermittent upgrading of an employee to a higher position as a vacancy-filling expediency. This action represents a form of training which often leads to a permanent promotion.

Certainly these nine factors are critical to the diagnosis, but cannot be considered all inclusive unless they, in fact, provide the basis for an effective program. The result of the analysis phase must be a comprehensive portrayal of minority employee utilization by job category, as well as the relationship to acceptable and reasonably available workforce resources. Any job category having fewer minority employees than would be reasonably expected by availability must be justified in detail, or translated into a goal.

Correction of Deficiencies

Goals and achievement timetables that form the basis of an affirmative action program flow from analysis. These goals should be significant, measurable, attainable, and provide comprehensive coverage in all job categories where minority groups are found to be underutilized.

The goals, timetables and affirmative action commitments must be designed to correct any identifiable deficiencies. This, with its attendant supporting data and analysis, is a mandatory part of a contractor's affirmative action program, and must be maintained at each of the contractor's facilities.

In carrying out a program, analysis and goal setting must receive special emphasis in those six areas found through experience to be weakest in minority utilization—officials and managers, professionals, technicians, sales workers, office and clerical, and skilled craftsmen.

The guidelines are clear, and enforcement provisions are available for dealing with contractors who fail to comply. These provisions are designed to provide the time necessary for a contractor to correct his deficiencies.

When a contractor is found lacking in his affirmative action program, the contract compliance agency puts the contractor on 30-day notice. During this period, he must either comply or show cause why enforcement proceedings should not be initiated.

If compliance is not achieved, or a good and sufficient cause for non-compliance is not presented within the 30 days, the compliance agency, with approval by the Office of Federal Contract Compliance, may issue a notice of proposed cancellation of existing contracts or subcontracts, coupled with debarment from future government business.

Following this notice, the contractor will be given a 10-day period in which to request a hearing. If no request is forthcoming, the contractor will be declared ineligible for future contracts. Existing contracts will be terminated for default.

During the "show cause" period, the compliance agency will make

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every effort to resolve the non-compliance deficiencies through conciliation, mediation and persuasion.

Equal employment opportunity initiative and accountability rest with the contractor to the same extent it does for compliance with any other terms and conditions of his contract. Industry management has a legal and moral obligation to set challenging and achievable goals leading to equal employment opportunity in its truest form.

Top management's influence is far more potent in its example than in its directive. In addition to verbal recognition, management must provide evidence through its demand for action —not merely understanding. Those involved in policy implementation, at all levels, must be made to understand that their future is directly related to their support. They must be tough minded—it concerns a tough problem calling for straight talk.

Companies may have a policy of nondiscrimination, but individuals, and groups of individuals, in an organizational structure practice discrimination. By its very nature, an act of discrimination typically emanates from the decision of one person, or a relatively small group of people. From this it follows that an effective program requires individual conversion, and solutions cannot be founded on organizational directive alone.

The policy of achieving a climate of equal employment opportunity must be supported with as much vigor as those directed at effective and profitable competition in the market place.

If It Is To Be, It Is Up To Me!

Excerpts from speech by Rear Admiral Joseph L. Howard, USN, Dep. Dir. for Contract Administration Services, Defense Supply Agency, to Contracts Compliance Office personnel attending a conference at Cameron Station, Va., Feb. 25, 1970.

* * * * *

It took courageous men, 200 years ago, to stand and fight for the freedom, the equality, and the individual self-respect we won in the American Revolution.

. . . it takes equal courage, and perhaps more, to fight today for the freedom, equality, and self-respect of *all* our people—all American citizens —in the well established society in which we live today.

You are among those courageous people. And those who have fought for the same ideals that you stand for can be found throughout the history of our nation.

* * * * *

. . . the United States faces a real crisis in the coming decade. The outcome, believe it or not, depends in great measure upon what you people here today do in the months immediately ahead not only by yourselves, but through the leadership you exercise, through the guidance you give your helpers, through the standards you insist upon in approving equal opportunity plans presented by our contractors.

* * * * *

Gentlemen, we must recognize that equal employment opportunity in our country *is not yet a fact.*

Certain groups of people have simply been cut out of the mainstream of our economy. We have identified these groups. We have analyzed them, discussed their condition, explained their plight, debated their values, and rationalized their failures. But we have not yet insured their equality.

It is becoming less and less important *why*
the black man
and the Indian
and the Oriental
and the Spanish-American
so often living in ghettos, receive inferior education, work only at the lowest paying jobs. The important thing now is that these are the facts, and we must correct these inequities.

* * * * *

We are the ones who have the responsibility.

We are the ones who face the challenge of peaceful, constructive, progressive changes—now and in the months immediately ahead—that can provide the equality for all our people that is so sorely lacking now.

Individually, we may think our part is quite small. But collectively, we are perhaps as important an operation as exists anywhere in the country today in the drive for equal job opportunity.

The civil rights problem is an issue of the first magnitude in our country. Contract compliance and equal employment opportunity are only a part of the total problem. But we must view the Contract Compliance Program within the context of the total problem.

We must recognize that we face the brutal possibility that our nation may be drifting toward two societies—one

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black, one white—separate, but unequal.

We must recognize that part of the strength of our nation has long been the heterogeneity of our citizenry. We have not been divided along lines of race, creed, nationality, or color where it comes to love of our country, loyalty to our flag, or willingness to fight and die for the American ideal.

We are part of a complex economic system in which we depend on the specialized abilities, skills, products, and services of each other.

The best interests of our country will be served only if we insure that *all* our people—black, white, red, yellow, brown—are given full opportunity to realize their fullest potentialities, their innermost hopes, dreams, and aspirations within the framework of individual responsibility and mutual respect among all people.

* * * * *

With a decent job, one that challenges his abilities, one that offers him the chance for advancement for betterment of his lot in life, one that permits him to plan happily for his children's own future, these problems ultimately come down to solutions which individual men can and will, if given a chance, work out by themselves.

I refer now to the joint responsibility of the Government and the business community.

I believe that the solution to the problems of our country lies within our grasp, but only if the Government and the business community are willing to make a full commitment to working out the solution.

* * * * *

We must get at the *subtle* areas of discrimination. In our reviews of company personnel practices, we must ferret out those areas that are buried deeply in the personnel files, the files that show where a white girl with a high school education and no working experience was hired into the accounting department in preference to a black girl with a college degree who applied at the same time for the same job.

We have to dig out those cases where a white man in the machine shop with 10 years experience was made foreman over the head of a black man with 15 years of identical experience and who displayed the same ambitions, leadership qualities, and supervisory potential.

We aren't going to make much of a dent in the problem by perfunctory reviews of personnel practices in the companies we do business with. We've got to dig deeply, and look at individual hiring cases, individual promotion cases, individual transfer cases, individual training opportunity cases.

We have got to inquire into specifics and see who the companies hired, and why, who they promoted, and why, who they gave training courses to, and why.

In other words, we must not be content merely with initial hiring practices. We must work closely with industry to rectify past wrongs. We must now vigorously embark on a program of upgrading the basic skills, the state of training, and the educational levels of those who do not now qualify, simply because they have never before been given a chance to qualify, or an opportunity to show what they can do.

The name of the game, gentlemen, is *affirmative action.* This means action all the way up and down the line, in all aspects of personnel administration, not just hiring, but also promotions, training, transfers, career incentives, and opportunities for company-sponsored graduate education.

I can assure you directly, here and now, that I personally, without reservation, am committed to this effort. You have my complete support, and I will repeat this to your regional commanders during our next commanders' conference.

You and your people must make this program part of your own conviction, your own belief, your own code of ethics—in this, we will have but a good start.

We must then be articulate, vigorous, and convincing in showing company officials that a fully integrated workforce, and a completely fair and equal personnel program, will mean progress, profits, and prosperity for their companies.

It comes down to your own individual conviction, and the sincerity of your commitment to this noble effort.

In short, the success of the Contracts Compliance Program depends upon you individually.

* * * * *

Army Seeking R&D MOBDES Officers

A new career program for research and development reserve officers has been announced by the Army. Approximately 767 positions throughout the Army are available for Mobilization Designees (MOBDES) who want to work in research and development. Designees train two weeks each year in their assigned position, preparing to perform full time in the event of mobilization.

Qualifications include experience or education in research and development. Additional information may be obtained by writing to the Office of the Chief of Research and Development, Washington, D.C. 20310.

Applications for research and development positions should be submitted to the Commanding Officer, U.S. Army Administration Center (USAAC), Attention: AGUZ–RA–SM, 9700 Page Boulevard, St. Louis, Mo. 63132, on DA Form 2976, Applications for Mobilization Designation Assignment. Form 2976 is available from Army Headquarters, Army Reserve Centers, or USAAC.

"Fly-by-Wire" for Aircraft Tested for USAF

A device which may replace a pilot's control wheel in future aircraft is being tested by the Air Force Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio. Called a dual sidearm controller, it is currently being tested in a variable stability B–26 aircraft, programmed to simulate the flight characteristics of a B–1 aircraft.

Dual sidearm controllers are built into the co-pilot's seat frame, and are designed expressly for a fly-by-wire (electrical) flight control system employing heavy augmentation. The controls are worked by either or both of the pilot's hands, and control up-and-down and right-and-left movement. They are similar to a pilot's control stick.

The device was developed by Hughes Aircraft Co., and is being tested by Cornell Aeronautical Laboratory, Inc. David Frearson is the laboratory's project engineer for the dual sidearm controller.

"Matters of great public Import may be committed to the Sole care of these Men"

James E. Casey

The objective of Defense Department personnel security policies is to protect national security interests, with due regard to the rights of individuals. DOD seeks to achieve this objective by assuring the trustworthiness of individuals who are to have access to classified defense information or who perform sensitive duties in the defense organizational structure. Individuals affected by these policies are all military personnel, DOD civilian employees occupying sensitive positions, and defense contractor employees who require access to classified defense information.

The first personnel security screening program in the United States probably was that started during the Revolutionary War by General George Washington, when he formed a personal guard. On April 30, 1777, he wrote to Colonel Alexander Spotswood, in part:

> "Sir: I want to form a Company for my Guard. In doing this I wish to be extremely cautious; because it is more than probable, that in the Course of the Campaign, my Baggage, Papers, and other Matters of great public Import, may be committed to the Sole care of these Men. . . . When I recommend care in your Choice, I would be understood to mean Men of good Character in the Regiment, that possess the pride of appearing clean and Soldierlike. I am satisfied that there can be no absolute security for the fidelity of this Class of people, but yet I think it most likely to be found in those who have Family Connections in the Country. . . ."

Today, "Matters of great public import" are committed to the care of people in Government and industry. While "there can be no absolute security for the fidelity of this Class of people," trustworthiness is still evidenced by a person's character and behavior in the community.

Policy for safeguarding classified defense information in the Federal Government is based on Executive Order 10501, "Safeguarding Official Information in the Interests of the Defense of the United States," issued on Nov. 5, 1963. Section 7 of the order states "knowledge or possession of classified defense information shall be permitted only to persons whose official duties require such access in the interests of promoting national defense and only if they have been determined to be trustworthy."

Government Employees

Congress recognized the role of people in assuring the security interests of the Federal Government when it passed the Hatch Act on Aug. 2, 1939. The original Section 9A of that Act barred government employees from "membership in any political party or organization which advocates the overthrow of our constitutional form of government in the United States."

On Aug. 26, 1950, the 81st Congress enacted Public Law 733, which authorized the heads of 11 Federal agencies, including the Secretary of Defense and the Secretaries of the Military Departments, to remove civilian employees from their employment in the interests of national security, without following Civil Service Commission procedures. However, the Act provides that a U.S. citizen employee, who has a permanent or indefinite Civil Service appointment and who has completed his probationary period, is entitled before removal to a written statement of the charges, a hearing, a review of the case by the head of the agency or his designee, and a written statement of the decision by the agency head.

Enactment of Public Law 733 was followed by Executive Order 10450, "Security Requirements for Government Employment," on April 27, 1953. It extended the authority of Public Law 733 to the heads of additional agencies not listed in the statute, established minimum investigative requirements for employment in the Federal Government, and provided a standard and procedure for assuring "that the employment and retention in employment of any civilian officer or employee within a department or agency is clearly consistent with the interests of national security."

Executive Order 10450 also set forth criteria for making determinations under the standard. These criteria include: behavior, activities, or associations which tend to show that the individual is not reliable or trustworthy; criminal conduct; drug addiction, excessive use of intoxicants; mental illness without evidence of cure; advocacy of the use of force or violence to overthrow the Government of the United States.

DOD Directive 5210.7, "Department of Defense Civilian Applicant and Employee Security Program," based on Executive Order 10450, was published on Aug. 12, 1953. The directive was reissued on Sept. 2, 1966, extending the hearing procedures contained on Public Law 733 to probationary employees.

DOD Directive 5210.7 defines a "sensitive position" as one in which the occupant could bring about a material adverse effect on the national security by virtue of the nature of the position. Hearing procedures and other administrative matters are set forth. Also, it provides that applicants being considered for sensitive positions should be given an opportunity, where appropriate, to explain or refute derogatory security information before being rejected on security grounds. The directive provides for coordination in certain matters with the Federal Bureau of Investigation and the Civil Service Commission.

On June 11, 1956, the Supreme Court decided the case of *Cole* v. *Young*, 351 U.S. 536, which held that, although the President had the power to establish sensitive positions in all agencies under Public Law 733, he did not have the authority to designate positions as sensitive unless they were affected by the national security.

Military Personnel

Executive Order 10450 triggered a similar personnel security program for military personnel. On April 7, 1954, DOD Directive 5210.9, "Military Personnel Security Program," was published, and was reissued on June 19, 1956. It provides the current policy guidance for the acceptance, retention, or separation of persons in the Armed Forces in the interests of national security. It contains the same standard and substantially the same criteria stated in Executive Order 10450.

Although there is no statutory authority similar to Public Law 733 for the military personnel security program, its legal basis can be sustained under the Constitutional power of the President as Commander in Chief of the Armed Forces, the National Security Act of 1947, and Title 10, U.S. Code. Further, the courts have consistently recognized the authority of the President to enforce discipline in the Armed Forces.

DOD Directive 5210.9 requires that all persons initially enlisted or inducted into the Armed Forces complete an "Armed Forces Security Questionnaire." Information from the questionnaire is the basis for a screening program, followed by interviews and investigation where necessary. Its purpose is to identify and preclude the entry of persons into the Armed Forces where acceptance would not be clearly consistent with the national security. Additionally, a National Agency Check is conducted on all Armed Forces personnel upon entry into military service.

No person may be rejected for military service for security reasons without being given an opportunity for a hearing. In some cases, individuals are assigned to specially controlled duties as a security measure, but indefinite assignment of this kind is prohibited, except as prescribed by the Secretary of the military department concerned.

Industrial Personnel

An industrial security program was initiated by the Government during World War II under the general authority of Executive Order 8972, issued on Dec. 12, 1941. In the following years, each military department conducted its own program. DOD Directive 5220.6, "Industrial Personnel Security Review Regulations," published on Feb. 2, 1955, established overall DOD policies for making security clearance determinations in contractor employee cases. It did not provide the applicant an opportunity to confront or cross-examine those furnishing adverse information about him.

This directive remained in effect until the *Greene* v. *McElroy* case, 360 U.S. 474 (1959), when the Supreme Court held that, in the absence of explicit authorization by the President or the Congress, the Secretaries of the Armed Forces had no authority to conduct an industrial security program which deprived contract employees the safeguards of confrontation and cross-examination of their accusers.

As a consequence of the *Greene* case, President Eisenhower issued Executive Order 10865, "Safeguarding Classified Information Within Industry," on Feb. 20, 1960. This order, as amended by Executive Order 10909 of Jan. 17, 1961, authorizes the Secretary of Defense and the heads of certain other agencies to establish programs for protecting classified information furnished to industry. Also, it provides that an authorization for access to classified information may be granted to an applicant only upon a finding that it is clearly consistent with the national interest to do so.

Further, and of great importance to the applicant, this executive order affords him "due process" before his access to classified defense information may be finally denied or revoked.

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He must be given a written statement of the reasons for denial or revocation of access, an opportunity to respond in writing, a personal appearance proceeding, and reasonable time to prepare for his appearance. He may be represented by counsel, and cross-examine witnesses. He must be given written notice of the decision in his case, setting forth the finding on each allegation in the statement of reasons.

The publication of Executive Order 10865 was followed by the reissuance of DOD Directive 5220.6 on July 28, 1960. It established procedural guidance for processing personnel security cases. No criteria for making determinations were provided by Executive Order 10865; therefore, the criteria published in Executive Order 10450 were adopted for industrial security cases. DOD Directive 5220.6 was again reissued on Dec. 7, 1966, under the title, "Industrial Personnel Security Clearance Program." The major change was decentralization of final determinations to hearing examiners, subject to appeal to the Appeal Board in the Pentagon.

Approximately 2.3 million employees in 13,500 contractor facilities are affected by the Defense Department Industrial Security Program. Nearly all security clearances were granted upon receipt of investigative results without appeal proceedings under the provisions of DOD Directive 5220.6. In 1969, 1,016 appeal cases were processed under that directive. Of these 454 resulted in issuance of clearance, 247 resulted in denial of clearance, and 315 were not processed to a conclusion because of a change in applicant's employment or for administrative reasons.

Investigations

All personnel security programs discussed in this article are screening programs to evaluate trustworthiness. They rely upon personnel security investigations. Generally speaking, the minimum investigation upon which a security clearance is determined is a National Agency Check. It includes checks of the subversive and criminal files of the Federal Bureau of Investigation, and such other national agencies which may have records on the applicant. In a substantial number of cases, an expanded investigation is conducted to resolve or clarify unfavorable information and may include a personal interview with the applicant.

A background investigation, or full field investigation as it is called by the Civil Service Commission, is required for Top Secret clearances, critical sensitive jobs in Federal employment, and certain other positions requiring access to highly sensitive information. It is designed to develop pertinent facts concerning the loyalty and trustworthiness of the applicant. A background investigation includes a National Agency Check. In addition, it includes inquiries about education, employment, military service, credit rating, criminal records, citizenship, foreign travel and connections, and organizational affiliations. References and other individuals having knowledge of the applicants background are interviewed. Inquiries are *not* directed to applicant's religious beliefs, racial matters, political activities other than membership in subversive organizations, or his beliefs on constitutionality or wisdom of legislative policies.

Determinations

When investigation of the applicant is completed, results are furnished to the organization which requested it for a determination. In the vast majority of cases, this determination is a favorable one and is followed by clearance, employment in a sensitive position, or acceptance or retention in the Armed Forces.

The greatest care is given to making personnel security determinations. Applicants come from a great variety of environments. Deviations from the norms of human conduct vary in significance depending on the facts in each particular case. Evaluation of derogatory reports of personal conduct must be based on good judgment. Common sense must be applied in the ultimate determination, based upon *all* the information available.

Consideration must be given to such factors as the seriousness of derogatory conduct, its implications, its recency, the motivation for it. The degree to which such conduct was voluntary and undertaken with knowledge of the circumstances involved must be examined. To the extent that it can be estimated and is appropriate in a particular case, the probability that such conduct will continue in the future must also be estimated.

Relevant Court Decisions

No discussion of personnel security would be complete if it ignored the effect of court decisions and the constitutional signposts they have erected. The *Cole* and *Greene* cases have already been discussed. Others are:

- *Vitarelli* v. *Seaton*, 359 U.S. 535 (1959) established the rule that an agency, which removed an employee on security grounds, must follow its regulations for processing security cases, even though the employee could have been removed summarily without reasons being given.
- *Harmon* v. *Brucker*, 355 U.S. 579 (1958) held that a member of the Armed Forces was entitled to a discharge based upon the character of his military record.
- *Bland* v. *Connally*, 293 F2d 852 and *Davis* v. *Stahr*, 293 F2d 860, both decided on June 15, 1961, that an inactive reserve member of the Armed Forces may not be given less than an honorable discharge for alleged subversive conduct when he was not on active duty as a reservist.
- *Schneider* v. *Smith*, 390 U.S. 17 (1967) held that the Congress had not delegated authority to conduct a screening program to "ferret out the ideological strays in the maritime industry." The court observed that the statutes are to be read narrowly to avoid questions concerning "associational freedom" and other rights within the purview of the First Amendment to the Constitution.
- *Robel* v. *U.S.*, 389 U.S. 258 (1967) held the criminal provision of Section 5(a)(1)(D) of the Subversive Activities Control Act of 1950 to be unconstitutional because it exceeded the bounds imposed by the First Amendment to the U.S. Constitution. The Court observed: "We are not unmindful of the Congressional concern over the danger of sabotage and espionage in national defense industries, and nothing we hold today should be read to deny Congress the power under narrowly drawn legislation to keep from sensitive positions in defense facilities those who would use their positions to disrupt the Nation's production facilities . . . . while the Constitution protects against inva-

sions of individual rights, it does not withdraw from the Government the power to safeguard its vital interests."

• *Adams* v. *Laird*, decided by the United States Court of Appeals (District of Columbia) on Dec. 12, 1969, upheld the Defense Department in denying Mr. Adams a security clearance. The court reviewed the hearing proceedings and commented that the President had articulated a standard that classified information is to be made accessible to an applicant "only upon a finding that it is clearly consistent with the national interest to do so." It noted that this standard was adopted by DOD. The court approved the standard and the supporting criteria.[1]

The *Schneider* and *Robel* cases, in a large part, prompted the House of Representatives to pass H.R. 14864, on Jan. 29, 1970. This bill would amend the Internal Security Act of 1950 by adding a new Title IV "Defense Facilities and Industrial Security," which authorizes the President to establish an industrial security program similar to that now operated by the Defense Department, a "Defense Facilities" program for a select group of industrial facilities, and a port security program. The bill authorizes the President to provide for screening of personnel in support of these programs.

H.R. 14864 is an effort to modify the provisions of the Internal Security Act of 1950, to conform to the guidance furnished by the Supreme Court in the *Robel* and *Schneider* cases. Also, it would provide a statutory base for the DOD Industrial Security Program. The Senate Judiciary Committee now has H.R. 14864 under consideration.

In summary, personnel security is concerned with assuring that trustworthy persons are selected for military, government, civilian and contractor positions concerned with the national security. The policies of the Defense Department are based upon law, justifiable need, and concepts of fair play. Every effort is made to protect national security interests without unduly impinging on the individual freedoms guaranteed by the United States Constitution.

[1] *The applicant in this case has requested the Supreme Court to review his case but, at the time of this writing, no decision had been made on this request.*

Army Engineers Award Safeguard Site Contract

The largest contract in Army Corps of Engineers history was awarded for construction of Safeguard Ballistic Missile Defense System facilities near Grand Forks, N.D. The $137,858,850 contract was won by a four-firm joint venture of Morrison-Knudsen; Peter Kiewit Sons, Inc.; Fischbach and Moore; and C. H. Leavell. The contractor is authorized to subcontract 75 percent of the work.

Facilities of the installation include a Perimeter Acquisition Radar (PAR), which detects incoming ICBMs at 1,000-mile ranges and computes their trajectory. A Missile Site Radar (MSR), which takes information from the PAR 23 miles away, launches and guides Spartan and Sprint missiles.

PAR and MSR buildings will be as large as any built for DOD. The MSR building, partially buried, will be hardened and will contain shock isolation devices for the computers and other equipment. The PAR building, although above ground, will be hardened also. Supporting and utility systems will have both redundancy and reserve capabilities.

Separate diesel power plants for the MSR and PAR sites will be large enough to power a city of 25,000 people. They will be hardened, shock isolated and underground.

Missiles will be placed underground in reinforced concrete silos.

Initial work at the sites includes grubbing, grading, building bituminous roads, installation of utilities, and fencing. Expected work force is 300 by June and 1,700 by August. All work is scheduled to be completed by mid-1973.

The Huntsville, Ala., Division of the Corps of Engineers is responsible for design and construction of Safeguard facilities.

"DSA—An Introduction" Available from GPO

The who, what, why and where of the Defense Supply Agency is told in the newly revised edition of "An Introduction to the Defense Supply Agency."

The 46-page, digest-size book includes a brief look at DSA's scope of operations, organization and key personnel. The major portion of the booklet consists of short descriptions of the DSA supply centers and categories of procurement, depots, materiel distribution system, service centers, and defense contract administration regions.

Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, the price is 35¢. The order number is D7.2:d36/970.

AIM–82 Definition Contractors Selected

The Air Force has selected three contractors to further define the AIM–82 short range tactical air-to-air missile. The three system definition contractors are: General Dynamics Corp., Pomona Division, Pomona, Calif.; Hughes Aircraft Co., Missile System Division, Canoga Park, Calif.; and Philco-Ford Corp., Aeronautics Division, Newport Beach, Calif. Each contractor has been funded approximately $1.5 million.

Since the Navy also has a requirement for a similar new missile, the next step in the AIM–82 program will depend on a decision by the Secretary of Defense on how best to provide a new air-to-air missile for both the Air Force and Navy.

If approved for production, it will be used in the F–15 and F–14, and in other aircraft such as the F–4, A–6, A–7 and F–111. It is planned for use in the rapidly maneuvering "dogfight" role.

The AIM–82 missile program is directed by the Deputy for the F–15, Aeronautical Systems Division, Air Force Systems Command, Wright-Patterson AFB, Ohio.

FY 1971 Research, Development, Test and Evaluation, Army

Excerpts from statement by Lt. Gen. Austin W. Betts, USA, Chief of Research and Development, Department of the Army, before Subcommittee No. 3 (Research and Development) of the House of Representatives Committee on Armed Services.

Our FY 1971 budget request [for the Army Research, Development, Test and Evaluation (RDT&E) Program] of $1.7 billion is based on providing the equipment, material and techniques necessary to meet both the present and future threats to national security. . . .

. . . Air mobility is our first priority for research and development effort in the Army. Our primary effort in this area is directed toward the development of an attack helicopter. . . .

The Army's second priority for research and development effort is for intelligence acquisition and dissemination systems. . . . The Army has established a dedicated STANO Management System and appointed a STANO Systems Manager. STANO is an acronym for Surveillance Target Acquisition and Night Observation and is comprised of those means and materials organic to or in support of the Army in the field associated with information gathering and presentation capabilities used to find the enemy or facilitate night operations. . . . The type of devices included in the program are ground and aerial night vision devices, radars, special purpose detectors, optical and aural devices, unattended ground sensors and electronic warfare support devices. . . .

The annual research, development, test and evaluation, Army, budget request to Congress is divided into the eight Budget Programs.

Military Sciences

Budget Program 5000, Military Sciences, supports research and exploratory development in the physical, engineering, environmental, and medical sciences, as well as work related to Army manpower resources. . . .

Among the strong reasons for continued Army research and exploratory development are maintenance of:

- Continuity of effort required to conceive and develop the advanced weapon systems needed by the Army.
- Competent in-house staffs that can direct, monitor and assess the performance of basic and applied research contractors.
- Capability (experienced in both research and Army materiel development) to improve existing operational weapon systems.

[An] example is our materials research effort. We have been working on improved lightweight armor for some time, with recent success. Tests of this recently developed plastic material compared with that of other lightweight armor materials, such as nylon, doron, steel and titanium, show great promise. For an equal weight of armor, this new material permitted fewer penetrations by shell fragments than the best materials currently being used. We are developing a production base for this new material and incorporating it into an advanced lightweight armor design.

. . . We hope to improve and exploit this property in providing armor for helicopter windshields and armored vehicle viewing ports.

We are also developing a sapphire transparent ceramic material that can defeat .30 and .50 caliber AP projectiles. This material could be used in portholes and windshields of armor vehicles to provide a protected observation means for the crew and passengers.

Aircraft

Budget Program 5100 provides for development of aircraft and related equipment. To maintain a viable, effective organic battlefield movement capability, the Army considers air mobility as the number one research

Research, Development, Test and Evaluation Army

(Dollars in Thousands)

Budget Programs		FY 1970	FY 1971
5000	Military Sciences	162,683	176,200
5100	Aircraft	94,777	110,200
5200	Missiles	853,430	896,400
5300	Military Astronautics	9,300	10,700
5400	Ships, Small Craft	400	1,100
5500	Ordnance, Combat Vehicles	153,412	153,200
5600	Other Equipment	304,318	317,800
5700	Program Wide Mgmt Spt	51,500	52,300
	Total RDT&E Program	1,629,820	1,717,900

and development priority effort in the Army today.

The following priorities have been established for major aircraft systems:

1. Gunships.
2. Heavy lift helicopter.
3. Utility tactical transport aircraft system.
4. Manned aerial vehicle for surveillance.
5. Light tactical transport aircraft system.

The attack helicopter development program continues to be our number one priority. It is a part of the evolutionary concept of using an aerial platform for close support and antitank missions. The high priority of the gunship is based on the need to improve the responsiveness and increase the capability of air vehicles in providing close fire support to our maneuver units. . . .

As an example of our increasing research and development support to aviation, we are increasing emphasis on aviation technology and have a new program titled Advanced Helicopter Development. . . . We plan a broad technology program encompassing the design and demonstration of new concepts in rotors, innovations in rotary wing aircraft designs and maintainability and reliability. We require a rotary wing technology base equivalent to that of fixed wing aircraft. . . .

We have made excellent progress in solving the technical problems in the rotor control system that forced us to terminate the AH–56A production contract last year. We were assisted by the nation's foremost authorities in the helicopter field in this effort and we now know enough about the rotor system to solve the problem. Lockheed is well along in initial testing and final verification is expected in FY 71. The most significant progress on AH–56A has been in the armament and fire control subsystems testing. . . .

Missiles

The largest single line item in Budget Program 5200 is the Safeguard Defense System. . . .

. . . an advanced development program totalling $158 million is requested in FY 1971 for the Advanced Ballistic Missile Defense Program Element.

SAM–D is an advanced development program to prove the feasibility of advanced technological concepts that will lead toward the most cost effective replacement for Hercules and Improved Hawk.

. . . In November last year we successfully demonstrated the feasibility of launching the SAM–D missile from its shipping container. During the coming year, integration and testing of the hardware will be conducted. Limited engineering development will be initiated which will be a deliberate design definition to remove any over design features and reduce cost and complexity without degrading the system's capability to counter the threat. . . .

Lance is being developed to provide nuclear fires in support of the field army and is a replacement for both the aging Sergeant and Honest John systems.

. . . The decision has been made to field the Lance missile system with the new rocket engine (5-ring engine) . . . . The nuclear warhead is scheduled for production. Development of a non-nuclear warhead is continuing. A decision on the fielding of this non-nuclear capability will be made later this year.

Military Astronautics

Budget Program 5300, Military Astronautics and Related Equipment, supports the development of ground terminals and related equipment for space systems. The Army participates in space programs along with the Navy, Air Force and NASA and most of our work in this budget program is for the Defense Satellite Communications System.

Ship, Small Craft

Budget Program 5400 has the objective of modernizing Army peculiar marine craft and amphibious lighters used for ship-to-shore logistics operations. The program consists of developing: an improved Beach Discharge Lighter, and a Small Harbor and Inland Waterway Tug.

The increase in FY 1971 funds Beach Discharge Lighter improvements required as a result of combat evaluations in Vietnam. All work is done in conjunction with the Navy to avoid duplication of effort and with maximum utilization of commercially available equipment.

Ordnance, Combat Vehicles

Budget Program 5500 covers Ordnance, Combat Vehicles and Related Equipment.

By direction of the Deputy Secretary of Defense and in response to Congressional guidance, the Army has again reviewed the original design of [the Main Battle Tank] MBT–70 in detail to identify a more austere tank which could be available in the same time frame and at less cost to meet the Soviet mechanized threat of the 1970s. . . . A revised program requiring $36 million in RDT&E funds for FY 71 to pursue this revised configuration was recommended to the Deputy Secretary of Defense . . . and received his approval. The new program will delay first production from July to December 1975 and impose more stringent milestones along the way. . . .

Testing of the prototypes has confirmed the expectation of superior performance obtained from the combination of high horsepower, improved suspension system, and better driver location. . . .

In response to Congressional guidance concerning the application of the Shillelagh missile to the infantry and heliborne roles, we have expedited our evaluation and review of the recently received Philco-Ford detailed proposals for feasibility and development programs for both infantry and heliborne Shillelagh systems. Upon completion of this review, approval of a $5 million reprogramming action, and with Congressional approval, we are prepared to pursue a 6- to 8-month, infantry mode, feasibility demonstration program to answer such questions as:

- Can the problems of crew safety, launch transients, required lightweight electronics, and accuracy be overcome?
- Can these problems be solved without major missile modifications which preclude interchangeability between armored and infantry versions?
- Will the modified missile and associated ground support equipment result in overall reductions in cost?

• Will the time required before production and the end results of the developmental program meet operational requirements that are currently met by the TOW missile?

Other Equipment

Budget Program 5600, Other Equipment, covers a broad range of items of communications-electronics equipment.

Using a total system engineering approach, the Mallard program will provide for full operability of all of the functional elements of the tactical communication systems. A building block design concept will be used to provide the flexibility required to configure the system to the specific needs of the military forces and permit us to buy only the quantity of equipment needed for a given force structure.

The system is now entering the advanced development phase of research and development. In FY 1971, through the use of models and simulation, we plan to verify the correctness of previous technical conclusions, prepare specifications for engineering development and determine detailed, joint operational and quantitative requirements.

As a result of the President's policy statements of Nov. 25, 1969 and Feb. 14, 1970, the chemical and biological programs have been reoriented. All offensive biological work and all toxin work have been eliminated. The Chemical Warfare Program and the remainder of the Biological Research Program have been restructured. . . .

The Chemical Warfare Program emphasizes both the development of adequate defenses and a retaliatory offensive lethal and incapacitating agent capability. The defensive aspects of our chemical warfare program constitute better than half of our research and development effort since the Soviets are known to have large stockpiles of chemical agents and weapons. . . .

The Biological Research Program consists solely of research and development for a defensive capability against both toxins and germ warfare.

Examples of chemical warfare programs are the Modular Collective Protection System and the Binary Lethal Weapons System. This binary technology will eliminate the inherent problems of production, storage, transportation and handling of lethal chemicals. The binary technique of generating lethal agent consists simply of combining nontoxic materials within the ammunition at the time of employment, to form lethal agents of either the G-series or V-series.

Program-wide Management Support

Budget Program 5700, Program-wide Management and Support, provides for that portion of the research and development in-house effort that cannot logically be funded to a specific project in one of the other budget activities.

The major portion of this budget activity provides for research and development personnel, cost, travel and other applicable administrative expenses for the performance of research and development functions at major headquarters below Department of the Army level. Also included are the costs for the operation, management and maintenance of general purpose research, development, test, and evaluation facilities and activities which cannot be distributed to specific elements. This element is primarily a fixed cost item. Our FY 1971 request is for $52.3 million.

FY 1971 Research, Development, Test and Evaluation, Navy

Excerpts from statement by Robert A. Frosch, Asst. Secretary of the Navy (Research and Development), before the Senate Committee on Armed Services.

Research and Exploratory Development

There are two elements in the Research program. One is for In-House Laboratory Independent Research performed by our Navy laboratories, and the second element is for Defense Research Sciences. The In-House Laboratory Independent Research Program maintains for the Navy an in-house capability of assessing and advancing technologies critical to our military missions.

Seventeen patents were issued in FY 1969 for ideas developed under this program, and 10 additional applications for patents were submitted and are currently under review. Items included among the patents are an instrument for measuring absolute reflectance and transmittance at cryogenic temperatures, explosive welding, electrochemical cells for thermal batteries, a method of tempering unique specialty (martensitic type) alloys, and a polarized light reflectometer for improved infrared detectors.

The Defense Research Sciences Program supports research in the important physical, engineering, environmental, biomedical and behavioral sciences areas. This program is performed by the Navy laboratories and by university and industrial scientists. These efforts are carefully planned to generate new knowledge in those scientific disciplines that will contribute to improvements in naval options and capabilities.

In this regard, Section 203, Public Law 91–121, provides that none of the funds authorized may be used to carry out any research project or study unless such project or study has a direct and apparent relationship to a specific military function or operation. . . .

Some of our objectives and recent accomplishment of this research under Defense Research Sciences follow:

• Special plasticizer additives resulting in more powerful solid and liquid propellants; decreased radar interference caused by solid rocket motor exhaust; new batteries for meeting special Navy needs; and a

unique system for closed cycle production of electricity.

• The first large scale refrigerator to operate continuously below minus 457° F., an advance of prime importance to highly efficient, compact and reliable electronic systems for future use aboard ship and other weapons platforms.

• Completion of simulations of a wide variety of alternative inventory policies for the Polaris weapon system resulting in major reductions of inventory investments while maintaining current levels of effectiveness.

• Clarification of our understanding of structural stresses and characteristics associated with brittle failure in naval pressure vessels.

• Recent completion of the interagency cooperative Project TEKTITE I producing important data about man's psychological reaction to long duration (60 days) in an underseas habitat.

• The definition of environmental parameters within which Navy and Marine Corps personnel can function efficiently; improvement of methods for the diagnosis, treatment, and prevention of disease in combat areas; and prevention of biological deterioration of equipment and materials.

• Navy Arctic Research Laboratory at Point Barrow, Alaska, was developed to meet the growing importance of the Arctic to the Navy and the nation. The laboratory supports research in the Arctic Ocean and operates ice island research sites. The program emphasizes oceanography, underwater sound, sea ice, environmental conditions, and techniques of military construction on permafrost.

• The collection, at all depths and for extended periods by means of self-contained instrument capsules, of ocean current velocity, temperature and pressure data required for understanding long range sound propagation.

A significant portion of the Defense Research Sciences element, approximately 29 percent, supports the Navy's Oceanographic Research Program. . . . Research emphasis has increased in these areas which relate to acoustics, lasers, ultrasensitive instruments, high temperature materials, logistics, large scale integration of electronic circuitry, automatic digital communications systems, deep submergence, energy conversion, and human performance in the ocean environment.

The Defense Research Sciences element also provides funds to continue certain programs originally started in support of the DOD University Program (Project THEMIS). The THEMIS program will not be identified separately in FY 1971 and subsequent years. . . .

Research, Development, Test and Evaluation, Navy Program, by DOD Categories

($ Millions)

	FY 1969	FY 1970	FY 1971
Research	130.3	117.9	118.9
Exploratory Development	262.1	236.1	242.9
Advanced Development	296.7	280.8	347.3
Engineering Development	346.0	392.5	531.9
Management & Support	228.0	229.7	226.1
Operational Systems Development	928.4	942.6	730.2
TOTALS	2,191.5	2,199.6	2,197.3

Exploratory Development

. . . Some examples of this work include: In the field of vehicles, wind tunnel tests on a reversed velocity rotor are expected to confirm an anticipated possible increase in helicopter forward speeds. Silencing studies on submarines are leading to developments which may make the submarine less detectable by enemy sonars, active or passive. The application of solid state electronics promises an improvement in the reliability of aircraft electrical systems while reducing the total volume and weight.

Under the Command and Control Programs, the development of functional building blocks for the Advanced Avionic Digital Computer will provide design flexibility needed by the various operational avionics requirements projected for the 1975–1985 time frame. Work is progressing on computer mass memories using ferro-acoustic and plated film techniques which, in the next three to five years, should produce low cost and high density memories, which will be many times improved over that now available. In an additional 5 to 10 years, using electron optic techniques, we should see memory block densities of 50 million bits per square inch. . . .

Among developments for the Marine Corps are an ultra-lightweight HF transceiver and techniques of battlefield surveillance and detection. Also sought are improved swimmer propulsion units and cold water exposure suits, as well as terminally guided ground-based missiles.

In the Weaponry area, we are developing new propulsion systems for torpedoes. Methods of improving our ability to distinguish real from false targets and selecting from multiple targets are being pursued. Technology to support a light, all-weather missile system will be developed so that small craft can improve their self defense/offense capability.

In the Support area, we are developing technology to measure and predict the environment (the atmosphere, the oceans, and the nuclear warfare environment) to support Navy operations. . . . Deep ocean engineering studies will stress the development of techniques, tools and equipment for emplacing fixed structures on the ocean bottom. Techniques are being developed to prevent deterioration by water exposure of glass reinforced plastic so that it may be better used for pressure hulls.

Development efforts are being conducted in many other areas such as nuclear propulsion and shielding, satellites, surveillance, life sciences, deep search and retrieval, HY 180 steels and other materials for construction.

Management and Support

Management and Technical Support programs will be carried out in FY

1971 in the areas of antisubmarine warfare and strategic warfare.

We will pursue several smaller programs in FY 1971 including such programs as Missile Flight Evaluation Systems, Technical Information Centers and Mutual Weapons Development.

Air Warfare

. . . We have included three hardware groupings under this objective; Aircraft and Related Equipments, Air-Launched Missiles, and Air-Launched Ordnance.

. . . The major goals of our programs are: to improve our fleet-air-defense and air-to-air combat through more effective aircraft, acquisition and fire control systems, air-to-air missiles, and airborne early warning, command and control capabilities; and to enhance our offensive air-strike capability through decreased weapon delivery error (CEPs), increased weapons release stand-off range, improved airborne reconnaissance, and expanded night and all-weather attack.

The major *Aircraft and Related Equipment* programs are: the F–14A, E–2C, EA–6B and HXC (Heavy Lift Helo) aircraft; F–14B Advanced Technology Engine, and Airborne Integrated Reconnaissance System (AIRS).

. . . FY 71 funds will provide for first flight and initiation of Navy preliminary evaluation of the F–14A aircraft and its weapon system.

. . . FY 71 funds will provide for flight testing of two system prototype E–2C aircraft and continued engineering testing of the active elements of the integrated avionics equipments.

. . . FY 71 funds will allow completion of operational evaluation [of the EA–6B] and the continued development of this advanced early warning aircraft.

The HXC Helo is to be a crane-configured helicopter intended to lift 18-ton loads. . . . FY 71 funds will provide detail design completion, initiation of ground testing and evaluation.

Advanced engine technology for the F–14B is for the purpose of maximizing the F–14's air superiority fighter capability. The new engine will have approximately 40 percent more thrust and 25 percent less weight than the TF–30 engine in the F–14A. . . . FY 71 funds will provide for the continued progress in engine development and engineering design necessary for transition from the F–14A to the F–14B. . . .

The Airborne Integrated Reconnaissance System (AIRS) will provide fleet commanders with necessary real-time reconnaissance information. It is planned to engineer this system into the F–14 aircraft to provide an RF–14 as the Navy's next generation reconnaissance aircraft. . . .

The principal *Air-Launched Missile* programs are: the Harpoon Anti-Ship Missile; Condor and Bulldog Air-to-Ground Missiles; Phoenix and Agile Air-to-Air Missiles; and the Standard ARM Anti-Radiation Missile.

. . . FY 71 funds [for the Harpoon] will permit completion of the critical field experiments, test of the basic weapon concept, elements of contract definition, selection of a development contractor and initiation of engineering development. . . .

The Condor is to be an air-to-surface missile with an electro-optical (TV) guidance system. . . . We are considering a revised plan where we would continue the Condor in RDT&E phase to conduct a thorough system technical/tactical evaluation with research and development missiles to optimize system characteristics and configuration before committing the Condor to production.

The Bulldog close air support air-to-surface missile is an inventory Bullpup missile modified for use as an accurate weapon intended primarily for use by the Marine Corps. . . . FY 71 funds will provide engineering development, contractor demonstration and commencement of operational evaluation.

The Phoenix missile system will provide the F–14 aircraft with its primary fleet air defense capability. The Phoenix missile control system (AWG–9) will be capable of controlling other missiles as well, *i.e.*, Sparrow, Sidewinder, and Agile, and the M–61 Gun. . . .

Agile is a proposed passive, short range air-to-air missile. . . . FY 71 funds will allow concept formulation and advanced development to continue. Engineering development is planned to commence as soon as hardware tests and evaluations have confirmed that the missile desired can be engineered with high confidence.

Standard ARM is an anti-radiation missile to provide strike forces with a capability to destroy surface-to-air missile sites and Ground Control Intercept (GCI) radars. This program has recently undergone a thorough review in the Navy and the program is now directed toward development of improvements in the missile and modification of the APS–118 Target Identification and Acquisition System (TIAS) to improve its compatibility with the A–6 weapon delivery system at a somewhat lower cost. . . .

The predominant *Air Launched Ordnance* programs are: Conventional Ordnance Development; Unguided Conventional Air-Launched Weapons; and Aircraft Ordnance Safety.

FY 1971 Research, Development, Test and Evaluation, Navy Program, by Budget Activities

($ Millions)

	FY 1970	FY 1971
Military Sciences	139.3	142.2
Aircraft & Related Equipment	794.9	693.9
Missiles & Related Equipment	458.7	494.3
Military Astronautics	19.1	29.1
Ships, Small Craft & Related Equipment	296.3	377.7
Ordnance, Combat Vehicles and Related Equipment	100.4	89.0
Other Equipment	242.2	226.5
Program-wide Management & Support	148.7	144.6
TOTALS	2,199.6	2,197.3

The *Conventional Ordnance Development* program effort is directed toward development of an Anti-Personnel/Anti-Material (AP/AM) cluster weapon, an Incendiary Bomblet, improvement of our General Purpose Bomb, and a Lightweight 20mm Gun Pod. The AP/AM weapon is designed for use with the Rockeye dispenser. . . . FY 71 funds will allow continued engineering development and evaluation of prototype hardware which will lead to initiation of operational evaluation. The Incendiary Bomblet will also be packaged in the Rockeye dispenser. FY 71 funds will allow completion of bomblet and fuze designs and fabrication of development models for testing. Improvements of the General Purpose Bomb will investigate in-flight options, and increased cook-off time. FY 71 funds will allow completion of system effectiveness studies and initiation of advanced development of the bomb case design. The Lightweight 20mm Gun Pod is intended for use on helicopters and light attack aircraft. An aircraft pod is under development to house an inventory MK–12 20mm aircraft gun and ammunition. FY 71 funds will provide for initiation of engineering development and test development hardware of the XM–197, 3-barrel gun in a suitable lightweight pod.

The *Unguided Conventional Air-Launched Weapons* program contains four development projects in FY 71. The Multi-Purpose 20mm Round is aimed at developing a suitable 20mm round for joint service use and to provide improved penetration and fragmentation. . . . FY 71 funds will complete engineering development. Deneye is a project to develop air droppable anti-vehicle and anti-personnel mines. . . . FY 71 funds will continue engineering development leading to operational evaluation. Zap is a hypervelocity cluster-warhead aircraft rocket primarily used for flak suppression and vehicle destruction. It is expected to replace the 2.75 and Zuni rockets. FY 71 funds will support optimized general purpose warhead design and improvements in motor, pod and fins for cost reduction. The Fuel Air Explosive Weapon (FAE) is a weapon that maximizes the blast. The low speed delivery weapon has completed development. FY 71 funds will allow continued development to improve the high speed delivery capabilities.

Surface Warfare

. . . New weapons include area and point defense missile systems, as well as new gun ordnance. New hull types and new propulsion principles will be brought forward so that our new ships will embody the advantages of advancements in shipbuilding technology.

We are commencing the engineering development of the Advanced Surface Missile System in FY 1970. This system, now called Aegis, will include a combined antiair warfare/antisubmarine warfare (AAW/ASW) guided missile launching system and a modification of the existing Standard missile. Aegis is being developed primarily for installation aboard new ships that will join the Fleet in late FY 76 and beyond. . . . In FY 1971 we will move forward with the design and fabrication of the engineering development models to be installed aboard [the USS Norton Sound] test ship.

. . . We plan RDT&E effort in FY 1971 to upgrade the [Terrier, Tartar and Talos missile] systems to combat the increasingly severe threats such as the anti-ship missiles of the Soviet bloc.

In the *Combined AAW/ASW Guided Missile Launching System* MK 26 program in FY 71, we expect to finish most of the work on the construction of two prototypes of this launcher.

The objective of the *Point Defense Systems Development* program is the development of the Improved Point Defense Surface Missile System. . . . The improved system consists of all new equipment except the Sparrow missile. . . .

The components of the improved system are being developed under two projects: the new lightweight launcher, digital fire control system, and modification of the Sparrow missile will be produced by the NATO SeaSparrow Cooperative Development project. The Target Acquisition System and its integration with NATO SeaSparrow will be supported by the Point Defense Improvements project.

Both projects began engineering development in FY 70 and will continue into FY 71.

The Close-in Weapon System Project Phalanx, initiated in FY 70, should provide a self contained rapid reaction lightweight system capable of providing for a last ditch self defense against anti-ship missiles.

Conventional Ordnance Equipment supports engineering development effort leading to improved gun systems, fire control systems, rockets for gunfire support and antiship missile protection. We have delivered to the Fleet the 5" /38 Rocket Assisted Projectile (RAP) which increases the effective range of our present guns. Technical evaluation of the 5"/54 RAP is now underway.

The Bombardment Rocket will complete development effort. The 5"/54 Lightweight Gun (LWG) and the MK 86 Gunfire Control System are undergoing concurrent evaluation aboard the USS Norton Sound.

The Long Range Bombardment Ammunition project will complete technical evaluation in FY 70. This project utilizes subcaliber projectiles in 8-inch bag guns as a means of extending ranges.

The Major Caliber Lightweight Gun prototype as a 175mm gun will undergo firing tests. Requirements have been revised to provide that the production version of the MCLWG will be an 8-inch gun. This gun will be capable of firing conventional projectiles. The design work for a new projectile will commence in FY 71. The gun will also be capable of firing the existing inventory of 8-inch projectiles. The MCLWG will utilize the same MK 86 GFCS as the 5"/54 LWG.

Our effort in FY 71 will be continued development of the Major Caliber Lightweight Gun, and completion of evaluation of the 5"/54 MK 45 LWG.

Joint development of the marine Inertial Navigation System by the United States and the Federal Republic of Germany will be completed with the delivery to Germany of one unit and a production data package. The U.S. will continue the program to provide an automatic position update to the system. Evaluation of a system interface with NAVSAT and OMEGA will be started in FY 71.

FY 71 efforts in Night Surveillance Equipment will be directed toward the development and testing of a Shipboard Imaging System and Low

Light Level TV Systems. Development of Stabilization and Dual Magnification of Direct View Devices is continuing in FY 70.

The AIMS program is a tri-service project to provide IFF and Air Traffic Control for use by the military with integration with the FAA systems. Implementation of the system to meet FAA requirements will be completed by January 1973.

The development effort aimed at large multithousand-ton Surface Effect Ships in FY 71 has become primarily a Navy oriented program due to reduced participation of the Department of Commerce.

Strategic Warfare

. . . We have only one functional area [in Strategic Warfare], Sea-Based Strategic Systems, which includes all of the RDT&E, Navy, programs covering this mission objective. Fleet Ballistic Missile Systems, Fleet Ballistic Missile Command and Control and the Undersea Long-Range Missile System (ULMS) are some continuing major programs. Major increases in FY 71 include ULMS engineering studies and nuclear-powered ballistic missile submarine (SSBN) defense; decreases are in Fleet Ballistic Missile Systems modifications.

Other programs included in our FY 1971 effort are SSBN Defense, Sea-based Ballistic Missile Intercept System (SABMIS), Strategic Systems Technical Support, and Navy coordination with the Air Force managed Advanced Ballistic Re-entry System (ABRES). In addition we are requesting funds for Navy support to the Army Safeguard Antiballistic Missile Test Target Program.

. . . The Poseidon Development program is continuing on schedule to support initial deployment in January 1971. . . .

The SSBN Defense Program is developing technology to insure the long term security of our SSBN force. In FY 70 we are undertaking the gathering of data to further assess areas of vulnerability which might affect the security of the Fleet Ballistic Missile Force. For FY 71, funds will support further development in this area.

Development of improvements in the ability of our Fleet Ballistic Missile Command and Control communications network to survive nuclear attack continues. A higher power transmitter for the airborne VLF relay system, TACAMO, will complete feasibility demonstrations in March 1970. Construction of a Sanguine test facility in northern Wisconsin is complete. This test facility will primarily seek to demonstrate effective and economic ways of mitigating the interference effects of the extremely low frequency (ELF) system on the utility systems in the area as well as confirm propagation predictions. Research will also continue on ELF effects on the ecology as well as potential physiological hazards to man. . . .

We are continuing to develop the Undersea Long-Range Missile System (ULMS). In FY 1971 we plan to complete the preliminary ship design.

The Sea-Based Ballistic Missile Intercept System (SABMIS) concept, which is under study, might provide early detection and intercept of missiles far from the continental United States and thus possibly provide, with the Safeguard system, a defense-in-depth against ICBMs.

In FY 1971 for Anti-Ballistic Missile Support we are to configure excess, no longer deployed, Polaris missiles as targets in support of the Army Safeguard Program. Continued Navy support of this Army program is anticipated through the end of FY 1973.

Antisubmarine Warfare

Our emphasis in antisubmarine warfare (ASW) research and development systems for FY 71, exclusive of research and exploratory development, is directed largely in two areas. The first is the development of the S–3A carrier-based aircraft. . . .

The second area of importance is the development of better acoustic sensors for all ASW platforms.

In order to obtain data necessary for developing future surveillance systems, we are engaged in the Long Range Acoustic Propagation Project (LRAPP). Under this project we will continue an experiment for collecting simultaneous acoustic and oceanographic data.

In order to improve the sensors of air ASW, the Navy has started development of Advanced Acoustic Search Sensor Systems. Primary efforts will be toward building on our new Jezebel capability to obtain an improved sonobuoy compatible with the present DIFAR processor.

In surface ship sonars we are planning near term improvements to the SQS–26 sonar. We are working toward entering contract definition for this improved variation of the SQS–26.

Our most important submarine sonar research and development program is the BQS–13 DNA development initiated in 1970. . . .

In anticipation of a still quieter threat in the late 1970s, we are studying an advanced sonar system for our new construction submarines of that period. This system, called New DD/New Sub Sonar, is planned as an integrated development of surface ship and submarine sonar systems in order to obtain maximum commonality.

In FY 71 the single largest ASW research and development effort, other than the S–3A and sensor systems, is the torpedo Mark 48. . . . We anticipate initiating procurement this fiscal year. Development of a dual ASW/Antiship version of this weapon will also continue.

Most of the remainder of our ASW research and development systems funding will be in countermeasures, command and control, and necessary ASW facilities and support including such facilities as AUTEC.

Marine Corps Programs

. . . The Marine Corps research and development program represents approximately one-half of one percent of the total DOD RDT&E budget request. . . .

Certain realignment of functions has been made which is expected to increase efficiency. For example, the Marine Corps FY 1971 research and development program places the Marine Corps exploratory development efforts under the technical management of the Chief of Naval Material. . . . In FY 71, then, although funding for Marine Corps exploratory development still appears under the two existing program elements, Marine Corps Weaponry and Vehicles Exploratory Development and Other Marine Corps Exploratory Development, the administration of these elements will rest with the Chief of

Naval Material. . . .

FY 1971 will see the completion of RDT&E funding for the LVTPX–12 family of amphibious vehicles.

The test program for the mine clearance version is scheduled for completion in FY 1971. In addition, production of the command and recovery versions will begin during FY 1971. Initial issue of the personnel carrier, recovery and command vehicles is scheduled for FY 1972 while the mine clearance version will be delivered to the Fleet Marine Force at a later date.

Advanced development will be initiated for the Position Location and Reporting System beginning in FY 1971. A feasibility study conducted under exploratory development will be completed in March 1970. This will be followed by procurement of brassboard hardware and the development of software for testing systems concepts.

The fabrication of a Service Test Model (STM) of the AN/TPQ–27 Radar System was initiated during FY 1970 for the Marine Direct Air Support System and a service evaluation will commence at that time.

. . . Studies currently proposed for FY 1971 range from Logistics Support Ashore for Sustained Operations, to Survivability of Troop/Cargo V/STOL Aircraft. The support provided by the Marine Corps Operational Analysis Group under the Center for Naval Analyses program element is closely related to the studies effort.

Oceanography

Underwater sound continues to be an essential sensor technique in undersea warfare, and over half of the Navy *Ocean Science Program* continues to be devoted to further understanding the environment's influence on it. . . .

The ocean engineering and development effort is directed toward the goal of permitting the Navy to operate effectively anywhere in the oceans, at any depths, and anytime. Our major project to develop a Deep Submergence Rescue Vehicle is reaching fruition. . . .

We will continue to develop new structural and buoyancy materials, power, vehicle control, and life support systems and other equipments and systems required if we are to operate effectively anywhere in the oceans. Our Deep Ocean Technology project is the focus for these developments.

Navy Oceanographic Program

($ Millions)

	FY 1969	FY 1970	FY 1971
Research, Test, Development & Evaluations	120.4	109.9	96.8
Ship Construction, Navy	0	0	7.3
Military Construction	4.6	3.1	2.7
Other Procurement, Navy	31.1	28.2	14.6
Operations & Maintenance, Navy	78.6	82.8	79.0
Manpower, Navy	12.8	10.5	9.4
Procurement, Aircraft & Missiles, Navy	0.2	10.8	0.4
	247.7	245.3	210.2

In the coming year, our biomedical research will continue to concentrate on the prevention and treatment of illness and injury of men below the sea's surface, and include techniques for the on-site treatment and evacuation of sick or injured divers.

We have restructured our planned efforts in the Man-In-The-Sea project since the aborted SEALAB III experiment of last year, increasing emphasis on safety and proceeding at a more deliberate pace to increased depths.

We are developing a system which will provide us with the capability of quickly surveying and producing navigational charts of militarily significant coast lines.

The National Oceanographic Instrumentation Center will be in its second year of operation. This center is funded, manned and managed by the Navy with policy guidance provided by a seven-member advisory board composed of representatives from DOD, Commerce, Interior, Transportation, NASA, National Science Foundation and the Smithsonian Institution.

Oceanographic operations in support of the Fleet will include continued hydrographic surveys. . . .

Ships in support of Polaris/Poseidon and Minuteman III will continue surveys resulting in charts derived for hundreds of thousands of track miles of data in the deep ocean and waters off the continental United States.

Oceanographic surveys in support of ASW will continue in the Atlantic and the Pacific. The USNS Wilkes . . . will become operational in late FY 1971 to replace the recently inactivated USS Rehoboth.

Cooperative surveys underway with Japan and Korea, and a third effort, with Norway, are about to commence. . . .

Recently delivered to Scripps Institution of Oceanography for use in Navy programs was the 245-foot, 2,100-ton R/V Melville (AGOR–14) which employs highly versatile cycloidal propellers for both propulsion and on-station maneuvering. Her sister ship, the R/V Knorr (AGOR–15) is currently completing construction and when delivered will be operated for the Navy by Woods Hole Oceanographic Institution.

Scheduled for delivery in 1971 as the final oceanographic research ship now under construction is the 3,000-ton catamaran-hull T–AGOR–16. This extremely stable platform will be used primarily by the Naval Research Laboratory in support of our underwater acoustics program.

The Navy budget contains a request for two of a new class of small (300-gross-ton) utility AGOR. . . .

Space

Under *Military Astronautics*, which term identifies the Navy Space Program, there are two major efforts in exploratory, advanced, engineering and operational development, which I would like to highlight.

In the *Satellite Communications Program* in FY 1971, we intend to expedite development of reliable shipboard communication terminals.

The *Satellite Navigation* effort is divided into two space-related tasks, Transit and Timation. . . .

. . . Four Transit and two Timation satellites are in orbit.

Timation II, launched by the USAF for the Navy late last year, replaced Timation I. The techniques developed in this program will be applicable to the Defense Satellite Navigation System (DNSS).

In the DNSS area, the Navy is assisting the Navigation Satellite Executive Steering Group (NAVSEG) in its efforts to define a Defense Satellite Navigation System by providing design information on the limitation of various navigation systems, delineating the extent to which Transit could be utilized, and developing system information which will describe the best utilization of the Timation ranging technique in a three-dimensional navigation system with near instantaneous fix capabilities. . . .

Electronic Warfare, Communications and Command and Control

The major effort in shipboard electronic warfare has been directed against the antiship missile. To this end, a Ship Anti-Missile Integrated Defense (SAMID) program has been established to integrate discrete systems into a total ship system responsive to the command and control organization. The Shortstop system, phase I of the Ship Advanced Electronic Warfare System (SAEWS) project will interface directly with the Naval Tactical Data System so that this important tactical information is immediately available to the force and ship decision makers.

The Big Look Improvement Program (BLIP) was completed in FY 70. This program provided for update and evaluation of advanced signal acquisition and precision direction finding systems. These advanced systems will have applications in follow-on aircraft to be developed under the TASES program, discussed next.

The Tactical Airborne Signal Exploitation System (TASES) program will provide for development of follow-on systems to replace current fleet EC–121M and EA–3B aircraft. . . .

Airborne Electronic Warfare Jamming and Deception efforts include development of improved electronic warfare countermeasures (ECM) systems for Navy attack, fighter and reconnaissance aircraft. . . .

Communications Traffic Management and System Control facilities, which are being developed, assembled and tested for installation in the USS Nimitz (CVAN–68), will consist of a Message Processing and Distribution System and a Facilities Control System. . . . Research and development efforts in HF Radio Digital Terminal Equipment are being initiated in engineering development to provide high data rate digital communication systems suitable for the long range transmission of data required for automated data system applications. In the UHF spectrum, work is ongoing for the fabrication and comprehensive testing of advanced development models of the Harpy System for tactical communications. Following the anticipated successful testing of these advanced development models onboard ship and in an aircraft, we plan to continue engineering development efforts in FY 1971 for the design and fabrication of equipments for fleet introduction and evaluation of the system.

The major emphasis of our development program for command and control is the exploitation of digital computer technology. . . . These command and control systems may be categorized functionally as real-time combat direction systems and related families of tactical command data and management information systems.

The *Command Data Systems* program in advanced development provides the technical base for the effective integration of new sensors and additional tactical functions into the Navy's combat direction systems. The initial prototype model of a new third generation family of shipboard computer modules, known as the AN/UYK–7(V) Digital Computer, was delivered to the Navy this year and is undergoing performance testing. We have also commenced developments in computer programming and the related software system necessary for the desired operational application and exploitation of the AN/UYK–7(V) processing system. This computer is now planned for data processing and control application in the LHA, DXG(N), SSN, and Aegis Missile Programs.

Development of a Junior Participating Tactical Data System is continuing in order to provide a small size Naval Tactical Data System of standard configuration but of limited capabilities. This system will be backfit installed during overhaul in the smaller AAW and ASW escorts, and will permit the rapid exchange of tactical information with other tactical data systems over a common digital communications link.

The *Joint Advanced Tactical Command Control Program* provides the development work for the design and testing of data system interfaces. As automated tactical data systems are conceived, developed, and implemented to meet individual needs in each of the military services, it is realized that there are facets of tactical information in each system which can provide mutual benefit to other units. In order to achieve the collective advantages of automated systems in a joint service environment, the Joint Chiefs of Staff require that compatibility and inter-operability be demonstrated through actual tests and exercises of those systems which may be used in joint operations.

The Integrated Flagship Data System program is continuing with the assembly, functional system tests and installation this year of a prototype system in USS Providence (CLG–6). We expect to conduct at-sea tests and fleet evaluations on this prototype flagship data system during FY 1971.

We are continuing our efforts in the ASW Force Command and Control System leading to the development of an ASW force-oriented integrated system planned for the mid-1970s. We expect to complete the definition of the integrated system design concepts with the funds we have requested in FY 1971.

FY 1971 Research, Development, Test and Evaluation, Air Force

Excerpts from statement by Lt. Gen. Otto J. Glasser, USAF, Dep. Chief of Staff, Research and Development, Hq., USAF, before the House of Representatives Armed Services Committee.

This year, the Air Force Research and Development, Test and Evaluation program totals $2,909.7 million. Of this amount, $1,205.1 million is for major system development. The balance ($1,704.6 million) will support our other system developments, technology efforts, and the operations of our laboratories and management elements.

Strategic Offensive Capabilities

Our Research, Development, Test and Evaluation program for FY 1971 includes several efforts dedicated to the assurance of our future retaliatory capabilities. In the manned aircraft category, the effort expected to have its first impact on our operational forces is our FB–111 program.

The FB–111A is being developed as an effective strategic bomber to replace some of our older B–52s. . . .

Our planned procurement is now 76 aircraft. . . . We are requesting $16.3 million for the FB–111A this year.

The B–1, formerly the Advanced Manned Strategic Aircraft (AMSA), is needed as a replacement for the B–52 to maintain an effective bomber deterrent force in the late 1970s.

Requests for proposals for airframe and avionics were released to industry on Nov. 3, 1969, and engineering development contracts using FY 1970 funds are scheduled for award late this fiscal year. The propulsion system will be provided as government furnished equipment to the B–1 systems contractor. The $100 million in the FY 1971 budget request is needed for these contracts.

To enable the B–52/B–1 bomber force to penetrate improved enemy area defenses expected by the mid-to-late 1970s, we will need a decoy with vastly greater capability and credibility than our present Quail. Therefore, we are developing the Subsonic Cruise Armed Decoy (SCAD).

Due to the urgent requirement for an early initial operational capability (IOC) and concern for minimizing technical risks within austere funding constraints, two time-phased versions of SCAD are planned. SCAD A is being developed primarily as a decoy for the subsonic B–52, but designed with an option to be armed with a nuclear warhead. SCAD B will be a longer range decoy specifically designed for use with the B–1 and also having the option for nuclear armament. The armed SCAD may be used to attack area defenses such as airfields, radar sites, or control centers.

SCAD is now in concept formulation. In-house and contractor studies have been completed on the preliminary SCAD A design. Engine and decoy electronic studies are continuing, and our aim is to produce a flyable, feasibility model of a multi-band electronics payload and a SCAD A antenna mock-up.

We are requesting $33.6 million in FY 1971 to continue SCAD A development and efforts on decoy electronics and propulsion.

A totally different kind of weapon system is provided by the Short Range Attack Missile (SRAM). Its purpose is to enhance the capability of the B–52, FB–111 and B–1 to attack terminally defended targets. . . .

Past development problems, primarily with the motor, have delayed completion of the development by 26 months. Solutions for the technical problems have now been developed and flight testing has been resumed. The $46 million research, development, test and evaluation funds requested for FY 1971 are needed to complete the series, the final test being scheduled for the near future. We expect that the SRAM development contract will be completed in September 1971.

. . . Minuteman III is scheduled for initial deployment in the near future and will incrementally replace the Minuteman I missiles in the force. . . . Its improved third stage and post-boost propulsion system will provide the capability to carry multiple Mark 12 re-entry vehicles together with related penetration aids. . . .

We are requesting a total of $224.2 million for Minuteman squadrons in FY 1971. Of this amount, $38.8 million is needed to continue such effort as general support and to perform further in-place and in-flight hardness testing on the Minuteman II. Funds in the amount of $185.4 million are needed for systems integration and testing, guidance and control support, post-boost propulsion system testing, and in-place and in-flight hardness testing for the Minuteman III.

Our efforts to date have included evaluations of the following possibilities: hardening the Minuteman sites; providing a close-in hard point defense of the silos; reducing hard rock silo costs; and providing mobility for part of the force through wheeled or air cushion vehicles and deceptive shelters. For FY 1971 we are requesting $77 million to continue these studies. . . . In addition, we plan to complete presently scheduled calendar year 1970 hard rock silo engineering efforts to insure against unknowns and to provide an orderly basis for possibly proceeding with future new silos.

In FY 1969, we began a development effort (MICCS) designed to improve the command and control of the Minuteman force. Our efforts included preliminary design and development of a system to allow retargeting of the Minuteman force through generating target constants at the launch control facility.

In FY 1971, under the Command Data Buffer program, we plan to continue developments that will allow us to more rapidly retarget our missiles. We are requesting $10 million for this purpose.

Major emphasis within this program [Advanced ICBM Technology] is concentrated on advanced guidance and post-boost vehicle technology. The advanced guidance work is directed toward improving system survivability and increasing accuracy. We are conducting tests to verify nuclear hardening techniques for inertial guidance systems and tests of

continuous calibration and self-alignment techniques. Our post-boost vehicle effort includes analysis of nuclear hardening requirements and techniques and examination of solid propulsion systems. We will continue this work with FY 1971 funds.

As executive agent for the Defense Department, we also manage an advanced development program to provide improved re-entry systems and penetration aids for *all* U.S. strategic ballistic missile programs.

Some of the techniques being investigated include masking re-entry vehicles with chaff, decoys and electronic and optical countermeasures. Others include hardening of re-entry vehicles to survive in a defended environment, and new fuzing concepts to optimize weapon effects for a selected target. The program also provides technological support for current re-entry system engineering developments such as the Mark 12 system for Minuteman III and the Mark 3 for the Navy's Poseidon, and for operational re-entry systems such as the Mark 11 system for Minuteman II.

As the executive agent for this Defense Department program, we are requesting $105 million for FY 1971 to continue this development and to test advanced re-entry systems and technology for all the services. . . .

Strategic Defensive Capabilities

The primary function of strategic defensive systems is to strengthen deterrence. By presenting a clear capability to detect and disrupt the pattern of a nuclear strike, defensive systems increase the enemy's risk that even his best planned strike may not prevent our effective retaliation. Their secondary function, should deterrence break down, would be to limit damage to the United States.

AIR FORCE RDT&E BUDGET ESTIMATES

(In Millions of Dollars)

RDT&E PROGRAM BY BUDGET ACTIVITY	FY 1970	FY 1971
MILITARY SCIENCES		
In house laboratory independent research	$ 4.3	$ 5.0
Defense research sciences	80.7	78.3*
Environment	9.5	8.0
Materials	23.3	23.0*
Preliminary design/development planning	4.2	4.0
Innovations in education and training	–0–	3.5
Air force project RAND	12.6	11.0
Analytic services, Inc. (ANSER)	1.5	1.5
Studies and analyses Air Force	.3	.3
Total Military Sciences	$ 136.4	$ 134.6
*These funds include laboratory operating costs.		
AIRCRAFT AND RELATED EQUIPMENT		
FB–111 squadrons	$ 45.4	$ 16.3
SR–71 squadrons	0.8	—
A–7 squadrons	1.1	–0–
F–111 squadrons	126.3	48.2
RF–111 squadrons	2.0	—
Aerial targets	1.2	—
C–5A airlift squadrons	34.2	11.6
Aerospace flight dynamics	32.1	31.0
Aerospace biotechnology	17.1	19.0
Aerospace propulsion	26.5	27.0
Aerospace avionics	46.0	44.0
Aircraft propulsion subsystem integration	8.0	8.0
Advanced aircraft navigation	5.6	4.4
Light intratheater transport	–0–	2.0
Flight vehicle subsystems	5.7	10.0
Advanced fire control/missile technology	3.0	2.8
Advanced reconnaissance and target acquisition capability	4.7	—
Aerospace structural materials	8.2	9.6
V/TOL engine development	8.0	5.0
Advanced avionics	6.8	8.6
Advanced turbine engine gas generator	7.5	—
Subsonic cruise armed decoy	9.1	33.6
National clear air turbulence program	1.0	.8
CONUS air defense interceptor	2.5	2.5
Quiet aircraft	3.0	–0–
Advanced aerial target technology	–0–	—
F–4 avionics	4.0	—
V/TOL aircraft (US/FRG)	2.0	—
F–15	175.1	370.0
Adverse weather aerial delivery system	4.1	–0–
A–X aircraft	2.0	27.9
Aircraft equipment development	14.5	11.9
Advanced tanker	.5	.5
B–1	100.2	100.0
Total Aircraft and Related Equipment	$ 708.2	$ 831.3
MISSILES AND RELATED EQUIPMENT		
Short range attack missile		
Minuteman squadrons		
Minuteman integrated command and contr		
Minuteman rebasing		
Command data buffer		
NIKE targets		
Rocket propulsion		
Advanced air-to-surface missile guidance te		
Air launched missile propulsion		
Advanced ICBM technology		
Advanced ballistic re-entry system		
Strategic bomber penetration		
Tactical air-to-ground missile (Maverick)		
Air-to-air missile improvements		
Hard rock silo development		
Sbort range air-to-air missile (AIM–82)		
Western test range		
Eastern test range		
Total Missiles and Related Equip		
MILITARY ASTRONAUTICS AND RELATED		
Defense support program		
General purpose applications		
Defense satellite communication system		
Special activities		
Satellite control facility		
Titan III space booster		
Manned orbiting laboratory		
Space studies		
Space applications planning		
Advanced space power supply technology		
Space experiments support		
Satellites, balloons and rockets		
Advanced space guidance		
Advanced liquid rocket technology		
Defense subsystem development and demo		
Tactical satellite communication		
Spacecraft technology and advanced re-en		
Satellite system for precise navigation		
Advanced satellite secondary propulsion sy		
Space data relay subsystem		
Advanced sensor technology		
Midcourse surveillance system		
Missile and space defense		
Satellite data relay system		
Aerospace		
Total Military Astronautics and		
ORDNANCE, COMBAT VEHICLES AND REL EQUIPMENT		
Advanced weapons and applications		
Conventional munitions		
Close air support weapons		
High energy laser program		
Conventional weapons		
Chemical-biological defense equipment		
Armament/ordnance development		
Improved aircraft gun system		
Truck interdiction		
Total Ordnance, Combat Vehicles Equipment		

These functions apply to both our missile defense systems and our bomber defense systems.

The nation's most serious defensive deficiency is our vulnerability to missile attack. Accordingly, we are investigating several concepts and related technologies for defense against future missile and space threats.

We are requesting $5 million in FY 1971 to continue our studies of an Advanced Missile and Space Defense system and supporting technology.

The Air Force has long believed that security from enemy missile attack requires a defense in depth that would enable early detection, tracking and discrimination of ICBMs, SLBMs and FOBs from boost throughout the midcourse and re-entry phases. . . .

We have initiated an advanced development program to apply new technology to the midcourse tracking and discrimination problem. A system employing satellite-based sensors looks promising, but we are investigating several alternate sensor/platform combinations to assure that no promising concept is overlooked.

. . . We are requesting $2 million to continue the conceptual studies and preliminary design work for this system.

The Advanced Sensor Technology program was initiated in FY 1970 to investigate the potential of various sensors for future surveillance and defensive systems. These sensors could be used in such system development as the Midcourse Surveillance System and Missile and Space Defense. The program will also develop optical instrumentation capable of evaluating the performance of penetration aids for offensive systems. To proceed, it is necessary that we first determine by an extensive measure-

	$ 84.7	$ 46.0
	353.0	224.2
m	20.0	–0–
	–0–	77.0
	–0–	10.0
	7.0	8.0
	24.7	25.0
gy	4.2	5.7
	.6	1.5
	15.0	—
	107.0	105.0
	2.1	—
	40.6	—
	2.7	–0–
	25.0	–0–
	14.0	37.2
	63.5	67.5
	143.3	118.0
	$ 907.3	$ 762.8
PMENT		
	$ 73.7	$ —
	9.5	—
	20.8	6.7
	239.8	—
	36.2	37.0
	51.3	35.4
	125.0	–0–
	1.1	–0–
	–0–	2.0
	1.7	3.0
	16.8	16.0
	1.0	2.5
	5.7	6.0
	11.0	5.0
on	13.1	–0–
	1.3	.7
s	2.2	3.2
	2.0	1.5
	.5	1.0
	2.4	—
	2.5	7.6
	–0–	2.0
	2.0	5.0
	.6	—
	22.2	19.5
Equipment	$ 642.4	$ 437.7
	$ 8.9	$ 8.0
	9.0	—
	2.0	2.0
	7.0	—
	15.1	—
	–0–	1.0
	13.4	11.0
	3.7	20.9
	10.0	10.0
elated	$ 69.1	$ 78.3

OTHER EQUIPMENT		
Strategic Air Command communications and control networks (SACCON)	$ .3	$ –0–
Post attack command and control system (PACCS)	.1	.7
UHF-emergency rocket command system (ERCS)	.8	2.8
Special purpose communications	1.7	–0–
Airborne warning and control system	40.0	87.0
CONUS over-the-horizon radar	2.8	5.3
Over-the-horizon radar system	2.8	3.0
Tactical air control system	2.5	4.5
Defense Communications Planning Group	14.0	—
Cryptologic activities	5.0	—
100th Strategic Reconnaissance Wing	12.2	—
Technical sensor collection	5.9	—
Intelligence data handling system	1.5	1.0
Air force communications	1.2	3.5
Traffic control, approach and landing system (TRACALS)	11.7	5.5
Air cargo materials handling	1.0	–0–
Ground electronics	36.5	35.5
Human resources	4.8	4.7
Over-the-horizon radar technology	2.0	1.5
Advanced devices	5.5	4.7
Advanced tactical command and control	3.7	4.0
Satellite communications terminals—tactical	1.8	2.0
Airborne satellite communications terminals—strategic	2.0	3.0
Loran D	1.8	3.6
Base security	1.6	1.6
Reconnaissance/intelligence exploitation	2.5	2.5
Penetration aids for manned aircraft	11.0	—
Simulator for air-to-air combat	1.0	–0–
Civil engineering technology	1.0	2.0
Design criteria for technical facilities	–0–	.5
Aeronautical Chart and Information Center	2.0	2.5
Integrated communications-navigation-identification	.5	2.0
Helicopter-borne radar	.6	.5
Advanced detection system development	8.6	—
Project Mallard	.3	1.7
Tactical information processing and interpretation	2.7	3.4
Air traffic control radar beacon system/air identification Mark XII system	.5	—
Joint advanced tactical command, control and communications program	2.0	1.0
Tactical jamming system	.4	—
Electronic warfare systems	10.8	—
Life support system	5.4	6.0
Other operational equipment	9.0	9.9
Lightweight precision bombing system	2.0	8.0
Intelligence/reconnaissance equipment	9.0	9.0
Systems survivability	1.8	—
Improved aircraft firefighting equipment	.5	.5
Sensors for weather reconnaissance activity	–0–	1.0
Cobra Mist	13.6	—
Arnold Engineering Development Center testing technology	7.6	7.6
Mapping, charting, geodesy	–0–	2.0
Common mobile supply equipment	–0–	4.0
Tactical electronic operational support system	–0–	—
Advanced airborne command post	1.0	2.0
Test instrumentation	5.9	–0–
Information Analysis Center	2.2	1.9
Electromagnetic Compatibility Analysis Center	5.4	5.5
Lincoln Laboratory	20.5	19.5
Mitre	11.2	9.0
Aircraft navigation system verification	.6	1.0
Total Other Equipment	$ 302.8	$ 359.6
PROGRAM-WIDE MANAGEMENT AND SUPPORT		
Development and test support	$ 139.7	$ 133.8
Acquisition and command support	173.9	170.9
International cooperative R&D	.2	.2
International military headquarters and agencies	.5	.5
Total Program-wide Management and Support	314.3	305.4
Total Air Force FY 1971 Research, Development, Test and Evaluation Budget	$3,080.5	$2,909.7

ment program the actual target signatures from re-entry vehicles and associated penetration aids, as well as the backgrounds which provide interference.

The $7.6 million in our FY 1971 program request will be used to begin measurement with sensors aboard satellites launched by our Space Experiments Support Program (SESP). Development will also begin on the instrumentation for suborbital flights aboard Atlas boosters to evaluate penetration aids developed under our Advanced Ballistic Re-entry Systems (ABRES) program.

We are requesting $87 million in the FY 1971 program to initiate systems engineering of an austere version of airborne warning and control system (AWACS). Prior to committing large sums of money for production, we plan to demonstrate with a prototype system that the AWACS mission can be successfully accomplished. . . .

. . . Our current program [for defense of the Continental United States] is to deploy over-the-horizon backscatter (OTHB) radars so they will have the capability to detect approaching bombers anywhere within their surveillance arcs out to significant ranges.

Our FY 1971 program request includes $5.3 million to complete contract definition and to begin development leading to an initial operational capability in 1975.

An improved manned interceptor with the capability to detect and destroy low altitude enemy bombers is essential to improving our nation's air defenses. Since the fire control and missile system is the longest lead time item in developing an improved interceptor, we are using funds available in FY 1970 to initiate the design and system engineering of an improved fire control/missile system. We will take advantage of technology and expertise derived from our earlier F–12 fire control and missile system work, the Navy's Phoenix System, and the radar systems now being developed for the F–15.

We are requesting $2.5 million in 1971 to continue system engineering of the improved fire control/missile system mentioned earlier so that we may design and fit the system to the selected airframe. If the airframe is approved in the near future and sufficient funds are provided, an improved interceptor could achieve an initial operational capability by the mid-1970s.

Tactical Air Capabilities

Operationally, . . . tactical air forces perform one or more of their classical missions: counter-air, including combat zone air defense; close air support; interdiction; tactical air reconnaissance; and tactical airlift.

With a variety of sensors for surveillance, its data processing and display equipment, its extended communications capability, and with delegated decision authority on-board, the AWACS is uniquely capable of serving as a tactical force control center. AWACS will provide positive control of strike aircraft, reduce aircraft losses, increase kills of enemy aircraft, and reduce missions aborted through premature release of weapons due to the threat of enemy air attack.

Although we are pleased with the technical excellence of the Mark II avionics system on the F–111D, cost increase have led us to limit its installation. Accordingly, we have developed a more austere avionics system consisting of components of the Mark IIB (FB–111 system) and of the Mark IIA (F–111 A/E system) for use in the later production fighters the F–111Fs. This system will be comparable in performance to the Mark II (F–111D) except in its capability for acquiring moving targets.

Flight testing by the contractor and the Air Force will continue this year and through FY 1971. The first F–111F with the new P–100 engine and the new austere avionics package is scheduled for its initial flight in the near future. This will lead to a squadron IOC shortly thereafter. We are requesting $48.2 million for the F–111 research, development, test and evaluation program, of which $18.8 million is to complete development of the P–100 engine.

During the past four years, we have made excellent progress in the development of suitable engines and radars for the F–15. Prototype engines have been running on test stands as a result of our joint Advanced Technology Engine project with the Navy. . . . Prototype radars will be flight tested, with engineering contract selection scheduled for October following the flyoff competition.

During FY 1971, we plan to continue with detailed design efforts and with wind tunnel, material structural and subsystem development testing. We also plan the release of long lead time items to subcontractors. We are asking for $370 million for these purposes.

Every modern war has reconfirmed the value of aircraft as mobile platforms for timely delivery of accurate firepower in close air support of engaged ground troops. The A–X is specifically designed for this mission. . . .

Studies directed by Office of the Secretary of Defense last year have been submitted along with our proposal to initiate engineering development late in FY 1970. We plan a competitive prototype development, in which two contractors will each build two aircraft. A competitive fly-off test program will determine which contractor will be awarded the contract for final A–X development and production. We are requesting $27.9 million to continue development of these prototype aircraft in FY 1971.

The SA–2 surface-to-air missile threat to our forces flying over North Vietnam motivated development efforts to counter this and other radar controlled defensive systems. The F–105 Wild Weasel detection and attack system was one of several methods employed in this countermeasures role. Therefore, we are developing a new system, tailored for the F–4D, and capable of vastly improved performance.

Earlier studies funded under the Aircraft Equipment Development line item defined the program, identified the necessary technical developments and performed some component development and testing. In FY 1971, we plan to continue development of prototype systems, complete the necessary qualification, reliability and integration testing, and install the system on an F–4D aircraft.

In our Aircraft Equipment Development program, we develop, test and evaluate a wide variety of subsystems and equipments, drawing heavily on

the results of our exploratory and advanced programs in avionics, propulsion, flight dynamics and materials. . . .

We are requesting $11.9 million in the FY 1971 program to continue work on such items as a radar correlation bombing system, sensors for target detection, advanced cockpit instrumentation and an advanced laser-/seeker designator. In addition to these developments, we are also investigating such items as palletized guns for converting transport aircraft to gunships.

To be reliable for combat situations, weaponry must be tested under operational conditions and on realistic targets. Accordingly, we have initiated a new program to develop advanced aerial targets and ancillary equipments for air-to-air and surface-to-air missile tests.

The primary project in our Advanced Aerial Target program is the High Altitude Supersonic Target (HAST). This new vehicle will provide all three services with a low cost target capable of operating at speeds varying from subsonic to over Mach 3 and at altitudes ranging up to 100,000 feet. Supporting tasks include development of advanced radar and infrared augmentation, which will more realistically simulate the radar cross sections and infrared signatures of threat aircraft. Unrealistic simulation has been a continuing problem in using small target drones. We have also had a problem in measuring how close our missiles come to the target drones in the event there is no direct hit. The Vector Miss Distance Scorer will solve this problem and aid us in evaluating the probability of kill of our missiles and in determining the correct warhead fuzing.

Maverick's first guided test flight last year was a success. It did lethal damage to a tank from a significant range. Further contractor testing of this nature is scheduled for completion in FY 1971.

During FY 1971, we also plan to begin Air Force Category II weapon system testing. . . .

The AIM–82A Short Range Air-to-Air Missile will be developed in parallel with the F–15 aircraft and optimized to operate along with it. However, the missile will also be made compatible with other fighter aircraft such as the F–14, F–4, A–6, A–7 and F–111. The F–15/AIM–82 interface analysis was completed in July 1969 and it is anticipated that contract definition will be initiated later this year. We are asking for $37.2 million in FY 1971 so that development of the AIM–82 missile may commence.

New guns and improved ammunition continue to be needed as essential parts of our aircraft armament systems. Our program includes development of a family of improved 20mm rounds for existing guns to achieve greater capability against lightly armored vehicles and personnel carriers. In addition, two completely new guns are in development: one for aerial combat and the other for close air support.

We are asking for a total of $20.9 million during FY 1971 for this program.

The immediate [Truck Interdiction] program goal is to provide our operational forces with improved munitions. . . . We plan to address longer-term solutions to the problem of vehicle destruction after we accomplish this immediate goal. We are requesting $10 million to continue our truck interdiction development efforts in FY 1971.

Our new [conventional] weapons are developed under three closely related research and development programs: conventional munitions, conventional weapons, and armament ordnance development. Conventional munitions is our exploratory development program in which we seek new weapons concepts and techniques, conduct studies to identify future weapon applications, and select the most promising items for continued development. Conventional weapons is the follow-on advanced development program, wherein promising weapons concepts are translated into prototype hardware for feasibility and effectiveness testing. Candidate concepts found acceptable by ground and flight tests are then forwarded for further development in the armament/ordnance development program. Here, engineering development of the most promising weapons is completed, designs are finalized and necessary testing performed.

We are requesting $27.5 million for all three programs in FY 1971. With these funds, we plan to continue our work in improved gun propellants, a hard structure munition, fuel-air explosive weapons, low cost optical fuzing and large cratering devices. We will also investigate a modular weapons concept, permitting interchanges among the warheads, guidance packages and other parts of the weapon and adaptation of our weapons to meet the demands of particular targets.

Airlift Capabilities

The tactical airlift force, consisting largely of aircraft over 10 years old, is aging at an accelerated rate due to wartime use rates. To modernize this force, we will need rugged and easily maintainable transport aircraft with sufficient performance characteristics and survivability for efficient operation from crude and very short airfields close to the battlefield. We will also need on-board, self-contained devices for rapid loading and unloading in unprepared areas.

The research, development, test and evaluation phase of the C–5A program nears completion. We anticipate that contractor and Air Force flight testing will be completed early in FY 1971 and that Category III operational suitability testing will begin sometime during calendar year 1970. . . .

We are asking for $11.6 million in order to complete this research and development program.

Our tactical airlift mission is presently being accomplished by C–130, C–123, and C–7 aircraft. . . . Our studies indicate that a new aircraft, the Light Intratheater Transport (LIT), is one of the stronger candidates to replace these older systems.

Either a V/STOL or STOL system provides a viable alternative to achieve tactical airlift modernization. We are deferring the decision as to which alternative will be selected. In FY 1971, we plan to continue and expand our work on promising V/STOL and STOL technologies, to initiate flight control investigations, and to continue our study of alternatives for the tactical airlift mission. Our program request contains $2 million to contribute to these purposes.

For some time we have recognized the inherent advantages of aircraft

FY 1971 RDT&E Air Force Program

($ Millions)

Major System Development

	FY 69	FY 70	FY 71
Strategic			
Aircraft			
FB–111 Squadrons	62.7	45.4	16.3
B–1	25.0	100.2	100.0
Subsonic Cruise Armed Decoy (SCAD)	1.7	9.1	33.6
CONUS Air Defense Interceptor	–0–	2.5	2.5
Missiles			
SRAM	135.3	84.7	46.0
Minuteman Squadrons	414.4	353.0	224.2
Minuteman Rebasing	–0–	–0–	77.0
Hard Rock Silo	23.0	25.0	–0–
Astronautics			
Defense Support Program	95.6	73.7	
Other			
AWACS	39.3	40.0	87.0
CONUS OTH Radar	–0–	2.8	5.3
OTH Radar System	1.8	2.8	3.0
Total Strategic	798.8	739.2	*
Tactical			
Aircraft			
A–7 Aircraft	7.4	1.1	–0–
F–111 Squadrons	99.6	126.3	48.2
RF–111 Squadrons	6.0	2.0	
F–15	68.5	175.1	370.0
A–X	–0–	2.0	27.9
Missiles			
Maverick	43.6	40.6	
Short Range Air-to-Air Msl (AIM–82)	2.1	14.0	37.2
Total Tactical	227.2	361.1	*
Other Mission			
Aircraft			
C–5A	126.0	34.2	11.6
Light Intratheater Transport	1.0	–0–	2.0
Total Other	127.0	34.2	13.6

* Total figure for this program not given because certain classified line items have been excluded.

with a vertical lift capability. Therefore, to increase the knowledge needed for development of an effective VTOL capability, we are pursuing technology efforts in three main areas: direct lift engines, propellers, and exploitation of foreign equipment.

The direct lift engine effort is being conducted jointly with the United Kingdom, and is currently in the engine test phase. We are close to achieving our technology goal, and by mutual agreement with the U.K., we will complete the direct lift engine effort during FY 1971.

Some VTOL utilizations, such as the Light Intratheater Transport and Advanced Rescue and Recovery System, will require a minimum amount of propulsion downwash. Therefore, we are investigating the technology of large diameter propellers—particularly the blade design, the gear box design and the use of new materials. Eventually, we plan to test a large scale propeller with cyclic pitch control. We are requesting $5 million to continue our propeller and exploitation efforts in FY 1971.

Technology Base

. . . To provide the base for the next generation of systems, I would like now to discuss some of the technologies that we believe will be needed "tomorrow."

Most of our technology results from our exploratory and advanced development programs. It is these development categories that provide the know-how and the techniques which prepare us to meet the needs of the next decade. . . .

The technology efforts closest to application in systems engineering are found in our advanced development programs. Several of the programs I have already discussed are in this category. While many of our other advanced development programs are equally applicable to specific system development, most are useful in more than one system. I will discuss a few of these to illustrate their role in the time-phased, building-block approach to weapon systems development.

The Advanced Turbine Engine Gas Generator (ATEGG) and Aircraft Propulsion Subsystem Integration (APSI) programs have fed directly into several system development efforts. In the ATEGG program, we design, fabricate and test gas generator cores using the latest component technology. These are not complete engines but long lead-time parts consisting of the compressor, combustor and turbine. We test only enough to prove that the core design can be used in a new propulsion system designed for a specific purpose. The B–1 demonstrator engine and the F–15 initial engine development are direct derivatives of this program.

Similarly, we have found that engines designed independently of airframes may have devastating results on overall weapon system performance. The Aircraft Propulsion Subsystem Integration (APSI) program is designed to provide the technical capability to integrate the engine with the airframe and obtain optimum performance from the total system. We are applying this technology to the F–15 development by providing

data on completed engine inlet tests to the F–15 contractors.

Another advanced development that has direct application to aircraft systems development is the Flight Vehicle Subsystem program. Since a major cause of aircraft losses to enemy ground fire has been damage to the flight control systems, we are developing a Survivable Flight Control System. This system is an all-electric, quadrupally redundant system potentially usable in the B–1 program.

Our Advanced Avionics program seeks to improve our ability to hit small targets under all conditions of visibility. The primary effort is devoted to development of sensors with their cockpit displays and to integration of these devices with other aircraft subsystems into a complete fire control weapon delivery system. The high payoff of this advanced development effort is illustrated by the forward looking infrared sensor and low light level TV now in use on aircraft in Southeast Asia. Current effort includes an electronically scanned, phased array radar antenna for strike aircraft and completion of an all-weather close support weapon delivery system.

One final advanced development I would like to mention is the Advanced Space Guidance program. The objective of this program is to develop and demonstrate an instrument which can indicate the precise pointing direction of various spaceborne sensors and communications antennas. Applications for this device include reducing ICBM target location uncertainties, improving space object surveillance and tracking, aiding precise navigation techniques, and improving satellite inspection.

We turn now to exploratory development. . . . In flight dynamics we are doing work in the five technical areas that will provide the technology for future aerospace vehicles: aircraft structures, flight controls, flight mechanics, dynamics and equipment. Representative of our work in this field are our efforts to reduce the weight and vulnerability of aircraft structures and to improve flight control and aerodynamic performance at transonic speeds. The components and technical data produced by this exploratory effort are used to produce subsystems and design data for advanced aircraft systems, including the F–15 and B–1.

Our Aerospace Propulsion program provides for technological advances in five functional areas: turbine propulsion, ramjet propulsion, electric power, electric propulsion, and fuels and lubricants. The individual components produced by this program are integrated into advanced propulsion systems and then into airframes for testing under two advanced development programs I mentioned earlier: Advance Turbine Engine Gas Generator and Aircraft Propulsion Subsystems Integration.

Avionics is one of our most important exploratory development programs. It advances technology in the areas of navigation and guidance, weapon delivery and fire control, aerospace surveillance, communications and electronic countermeasures. . . .

The Rocket Propulsion program provides the technology needed in both solid and liquid propellant rocket engines for new ballistic missiles, tactical missiles and space propulsion systems. We are concentrating our efforts on the design and operation of such items as thrust vector control, high energy propellants, and advanced cooled combustion chamber and nozzle concepts. . . .

Our work in the Advanced Weapons and Applications Technology program is closely coordinated with organizations such as the Atomic Energy Commission (AEC) and the Defense Atomic Support Agency (DASA) to develop concepts and equipment for the employment of advanced weapons. Our recent efforts on nuclear warhead design criteria for the Subsonic Cruise Armed Decoy (SCAD) and radar and infrared optical fuzing for hypersonic re-entry vehicles are representative of our many activities in this program.

The Ground Electronics program advances technology over a wide range of activities for application in the areas of surveillance, intelligence collection, data processing and display, and command, control and communications. . . .

One other exploratory development program, which is newly identified in our research, development, test and evaluation request this year, is Space Applications Planning. The analytical efforts in this program define advanced system concepts and evaluate the economical and technical feasibility of these various concepts. To date, we have conducted efforts in such high interest areas as space navigation, midcourse surveillance, satellite inspection, multipurpose reusable spacecraft, and the economies of recoverable spacecraft. We have also performed analyses on space escape systems, space antennae and other special defense projects. We are requesting $2 million to continue investigation into these and other important efforts.

HardiMan Helps Lift Heavy Loads

Mechanically muscled men are the objectives of a joint Army and Navy program called HardiMan (Human Augmentation and Research and Development Investigation). HardiMan is a metal exo-skelaton of general human configuration.

Under a contract with the Army Materiel Command and the Office of Naval Research, the Research and Development Center of the General Electric Co., Schenectady, N. Y., has produced a prototype left hand.

Test engineers at the Army Mobility Equipment Research and Development Center, Fort Belvoir, Va., were able to lift loads up to 750 pounds by mating their own left arm with the mechanical counterpart, which is also attached to a fixed stand at shoulder level. The entire unit should enable men to lift, lower and walk with 1,500-pound weights.

With its own power source, HardiMan will amplify every movement of its operator through hydromechanical circuitry linked through sensors. The operator will be mated to the structure at the arms, feet and girdle or cross piece. A system of levers, control linkages and servomechanisms will permit walking, bending, turning, or other movements with a minimum of restraint on the man.

Delivery of a complete prototype is expected in early 1971.

PROMPT

Rear Admiral Thomas J. Walker, USN

Design and fabrication of the many sophisticated weapon systems in the Navy's highly mobile carrier strike force has become increasingly more complex. Within the Navy, responsibility for aircraft and airborne weapons, as well as related shipboard and ground support equipment, necessitates central direction of the research, development, test, evaluation, acquisition, and logistic support phases associated with each project resulting from a Specific Operational Requirement (SOR).

The prime responsibility for developing the concept and subsequent acquisition of the ultimate in Naval air power rests with the Commander of the Naval Air Systems Command (COMNAVAIR), one of the six systems commands of the Naval Material Command. Responsibility for planning, directing, and controlling the definition, development, and production to meet an SOR is delegated, in turn, to NAVAIR project managers.

To achieve successful project management, there is always a need for management systems that are broad in scope, flexible in application, and that provide uniform data related to both contractor effort and government facilities, including government furnished equipment. Only through teamwork between the contractor and concerned government offices can successful project management be achieved. Summary data must be presented through these systems in a manner that is both meaningful and relevant. Data regarding trends in improvement or lack of progress in a system must be accurate and timely. Data systems must be standardized and integrated into a cohesive unit which will provide a flexible, comprehensive management tool for total project management.

Contractors and concerned government offices have recognized the need for complementary management systems. Approved systems are being formulated. The framework for effective management within the Defense Department has been established in the resource management effort which is subdivided into two major areas: Project PRIME consisting of programming, budgeting and operations management systems and Assets Management composed of inventory management systems and acquisition data and management systems.

NAVAIR's answer to the need for a management system is PROMPT (Project Reporting, Organization, and Management Planning Techniques). PROMPT encompasses total project management and is NAVAIR's means for executing the DOD Acquisition Data and Management System (Figure 1). This system, presently adopted on the S–3A and the F–14A aircraft projects, provides a means of monitoring the accomplishment of the acquisition plan with emphasis on supplying up-to-date data relating to project trends. Eventual use of PROMPT by all NAVAIR project offices will ultimately provide the command a uniform management system and an aid to smooth progress in the development of new weapon systems.

Besides fulfilling the need for total project management, other attributes of PROMPT are:

- Uniformity of management data.
- Flexibility to the extent that it can be tailored to specific needs of the project manager.
- A total system, documented and identified for contract purposes.
- Controls for both government and contractor effort.
- Timely and accurate management data for decision making by the project team.
- Parallelism in the phases of development of a weapon system.
- Achievement of requirements of the DOD and NAVAIR integrated management system.

Additionally, PROMPT is a part of the Council of Defense and Space Industry Associations' inventory of management systems.

Comprehensive Management Tool

As a tool for total project management, the PROMPT Management System is composed of five essential elements: acquisition plan, work breakdown structure, management techniques, management reports, and control manuals. Although certain guidelines must be followed in the use of these five basic and essential elements, each is flexible and can be constructed to meet specific project management needs. A brief explanation of each of these elements will give the reader an insight into the composition of PROMPT.

The Acquisition Plan, established by the Chief of Naval Material as the master planning document for the development, management, and procurement of weapon systems within the Naval Material Command, combines the Technical Development Plan and Project Master Plan to produce a principal project document. This document then serves as a basic source of input to all supporting plans, such as the advanced procurement plan, training plan, quality assurance plan, configuration management plan, systems effectiveness, etc.

The Acquisition Plan serves the dual purpose of defining and justifying the project for the Office of the Secretary of Defense, the Chief of Naval Operations, and the Chief of Naval Material. Concurrently, it provides guidance and support to project managers. It establishes a technical requirement summary; identifies the responsibilities of those involved in the project; provides the framework for life-cycle procurement, production, and integrated logistic support for the project. The Acquisition Plan establishes the requirements and formulates and formalizes the plans for project development.

The **Work Breakdown Structure** (WBS), evolving through several steps, serves as the foundation for execution and control of the project. WBS graphically displays as a family tree organization chart, the manner in which responsibilities are divided, resources are applied, schedules are determined, and work is planned and accomplished for the prime mission system and for the integrated logistics support of the prime mission system. WBS associated with PROMPT establishes a uniform and common communication system by providing a logical structure for collecting management data, preparation of reports, and analyzing progress. It provides a foundation for management data flow between the Government and contractor, whether it is concerned with cost, schedule, or technical performance.

On the basis of the SOR developed for the project, the total project effort is then divided into separate divisions of prime mission system and integrated logistic support. Each of

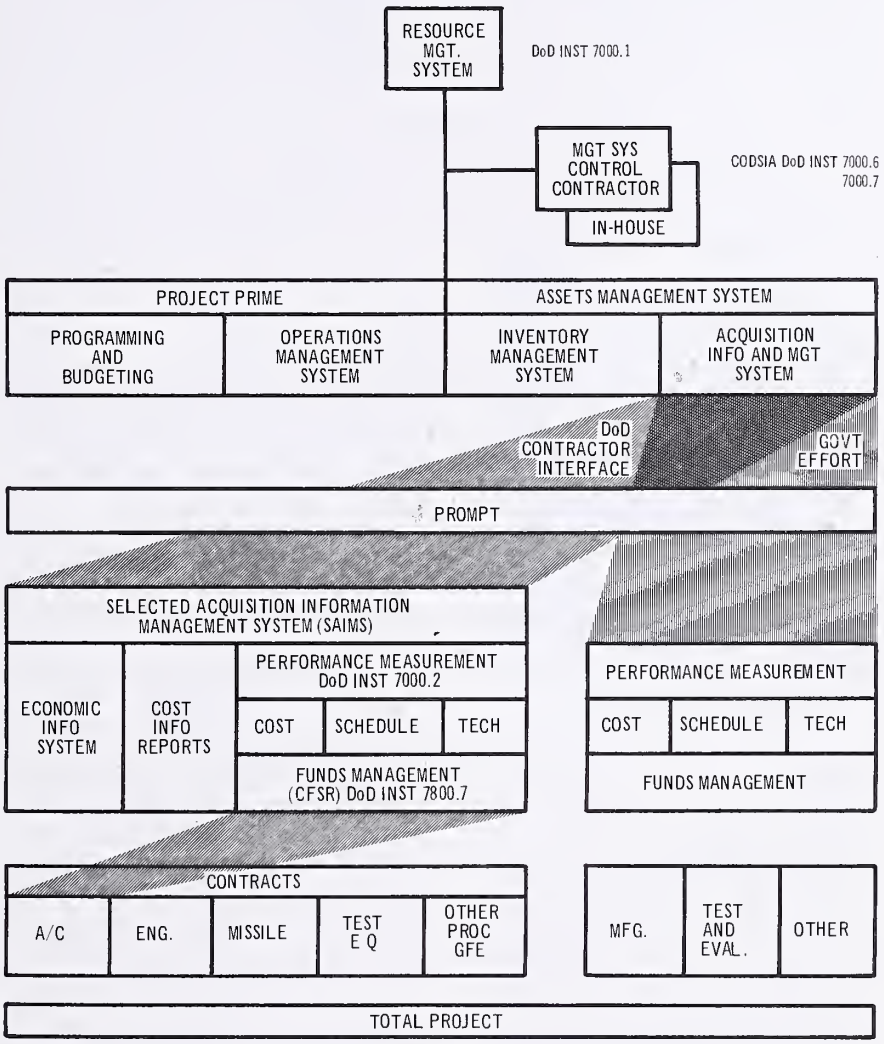

Figure 1.

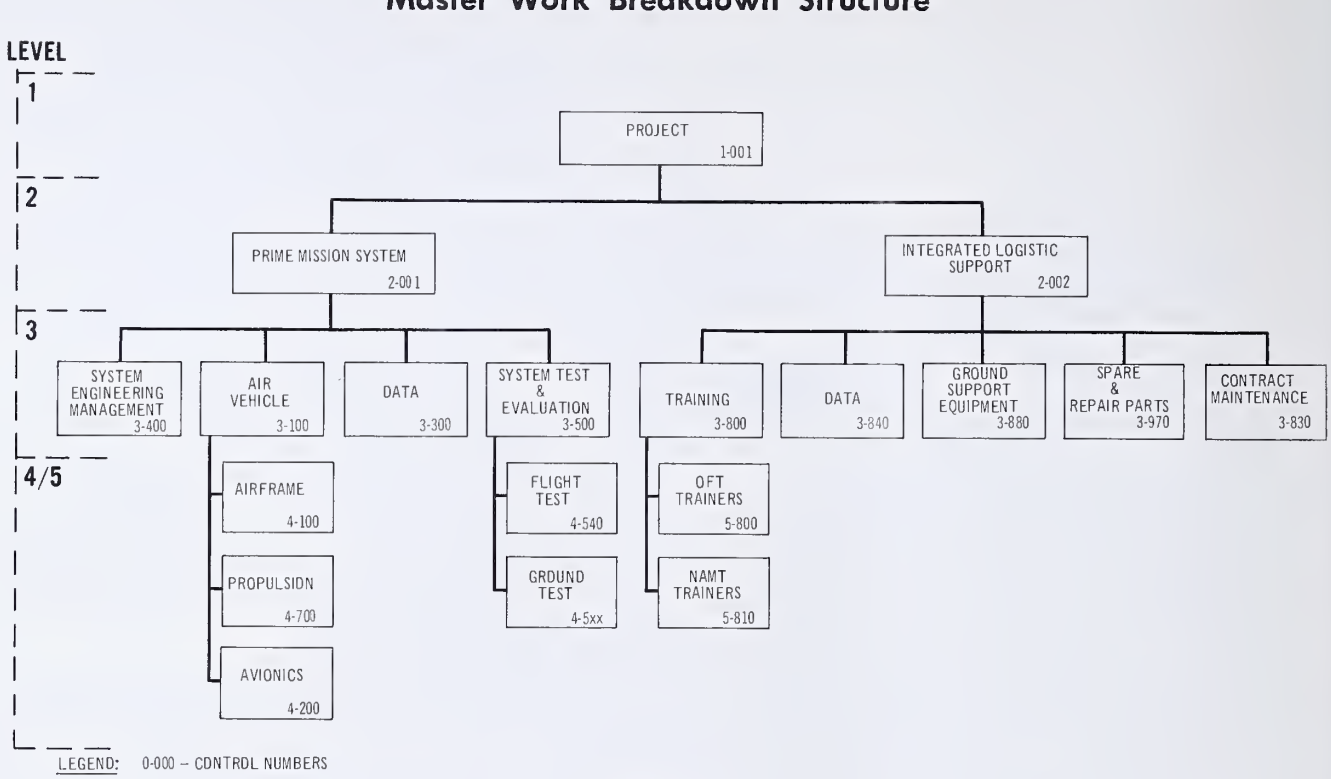

Figure 2.

these divisions is further broken down and classified into specific areas of work responsibility (Figure 2). Definitions for elements at these levels are made to conform to military standards.

Control numbers are assigned to each element of the work breakdown structure for the purposes of common communication (reference points) between the Government and contractor. When a contract is signed, a final complete project WBS is established for the total task to be accomplished, broken down into component tasks and work packages, subtasks, with elements of the prime mission system and integrated logistic system defined.

Any one element of a WBS will be looked at differently by various members of the project management team. To the engineer, an element such as an *airframe* must be technically correct and pass all tests. To the budget analyst, this same element is viewed in terms of *actual versus planned costs*. To the project manager, the airframe involves problems of *production* and *scheduling*, within *cost* and *technical* boundaries. In all cases, however, WBS identifies the particular area of work being considered and provides the common baseline necessary for proper data flow.

To coordinate the various project activities being conducted by the Navy, contractors, and government-furnished-equipment facilities, it is necessary to establish during the contract definition stage detailed work breakdown structures and schedules for each segment of the weapon system. Also, it is necessary to coordinate these schedules. The PROMPT Work Breakdown Structure Interface Network provides a visual portrayal of the sequence of development of each item on the contract, and links these paths together at appropriate action points. PROMPT provides the same basic project summary WBS to both the contractor and government facilities, from which each can develop extended WBSs in parallel. The end result of the WBS development process is orderly planning and the ability to relate time, cost, and technical performance reports to a common base.

PROMPT **Management Techniques** include:

- WBS Interface Network where detailed WBSs and schedules are established for each segment of the weapon system.
- Alignment of contract line items on the contract to the contractor WBS.
- Alignment of the NAVAIR tasks, assigned to the government facilities, to the contract/project summary WBS.

These techniques promote integration of the other elements of PROMPT into a total project management effort. The uses of management techniques vary within different phases of the procurement program.

Management Reports. The PROMPT Reporting System is based upon the premise that management does not require total information, but only summary data necessary for decision-

making purposes. The data to be reported results from the contractor's levels of the WBS, and may be in the internal performance measurement system. It flows from the functional departments of the contractor up through the structure of the WBS. Summary reporting occurs at the project and prime mission system levels of the WBS, and may be in the form of summary milestone charts, trend charts, etc. Control numbers, assigned to each element of the WBS, are used in communication to facilitate identification of subject matter under discussion.

Summary reports are forwarded simultaneously to the contractor's action center and to the Government. These summary reports are used to update control manuals in the possession of the project manager and his team. Thus, both the contractor and the Government are using the same reports and a common management system. PROMPT reports contain data regarding time, cost, and technical performance and can be designed to meet each project's specific needs. They consist of Hot Line Reports, Weekly Action Reports, Milestone Charts, Trend Charts, Variance Reports, and a series of Financial Reports. Briefly described, these reports are:

- Hot Line Reports are transmitted between contractor and government project managers. They are used to inform project managers of problems that require priority action in the areas of time, cost, and technical performance, and may be written as confirmations of telephone calls. The reports are serialized and, thus, provide a controlled communication system.

- Weekly Action Reports are intended for use by the project manager. They contain data on items of a routine nature, as well as those requiring immediate attention and action. They serve as a direct line of communication between the contractor and project manager.

- Milestone Charts perform a dual purpose. They present the schedules for project development and the responsible organizational segments, and also serve as a means for reporting progress made against these schedules. The charts are keyed to a WBS control number, thus specifying the exact areas of work under discussion in terms that are familiar to both the contractor and the Navy project management team. They provide the means for comparing costs to schedules for the given WBS number on a single form. These selected summaries are provided only for high level WBS status reporting, and are updated and submitted quarterly.

- Trend Charts reflect, at a glance, progress in meeting milestone target dates or some other measurable performance. The number of weeks ahead or behind schedule is indicated, and positive or negative trends are immediately visible. Trend Charts are used for technical, schedule, and financial data.

- Variance Reports are narrative in form and serve either as follow-ups to Trend Charts or as indicators of other problem areas that have developed. They define adverse trends that have been indicated on the Trend Chart, identify the impact of these trends, provide recovery plans, and indicate the required action that is necessary. Variance Reports are submitted on an "as-required" basis.

- Financial data is vital to project managers. They need to have data available concerning such areas as planned and actual expenses, financial trends, specific contract line items expenditures, and the status of the total appropriation. PROMPT Financial Reports reflect summary data taken from the internal performance measurement system used by the contractor and approved by the Government. They offer a comprehensive picture of the budget and appear in a variety of formats, allowing the financial status of the project to be studied in varying terms. PROMPT allows the project manager flexibility in his approach and meets his requirements through several types of financial reports:

Expenditures and Commitments Reports—monthly contractor-prepared reports in the form of trend charts. They graphically display planned versus actual amounts of money expended and committed, by appropriation. Use of these reports enables the project manager to forecast future trends in comparison with the original projected plan of expenditures and commitments.

The Cost Summary Status Report—a monthly contractor-prepared report. It is oriented to the work breakdown structure by item number and provides data regarding the latest total budget, estimated budget at completion, and current variances. Expenses are also broken down in terms of labor hours, labor dollars, overhead, government dollars, and planned value of work scheduled and accomplished. This report is useful to the project manager in predicting trends, especially because figures specifying estimated overruns and underruns are included in this report.

Contract Funds Status Report—a quarterly contractor-prepared report submitted to the project manager in the Project Profile Manual. It displays funding information to contract line items in terms of the total project being purchased from the contractor by fiscal year. This report also forecasts future funding requirements.

Cost Summary Trend Chart—a graphic portrayal of the financial status of the prime mission system project cost summary. Trends are re-

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Funding Control

(Dollar figures to nearest million)

WBS No.		Airframe Contractor	Engine Contractor	Missile Contractor	Other GFE	Government Effort	Funds by FY	
1000	Prime Mission System	$200M sum →	30 →	30 →	30 →	10 →	$300 sum	FY Funds by Oblig Plan
1100	Sys Engr & Project Mgt	3	2	3	—	2	10	
1200	Air Vehicle	142	18	15	28	—	203	
1300	Data	5	1	1	—	2	9	
1400	System Test & Evaluation	50	9	11	2	6	78	

Figure 3.

flected in the areas of planned value of work scheduled, planned value of work accomplished, actual cost, projection of the planned value of work accomplished, and a projection of the total cost.

Funding Control Matrix Chart—a demonstration of the manner in which project funding is developed and controlled by the project manager. The chart uses the PROMPT work breakdown structure as a foundation for data flow. Cost estimates are recorded for each major procurement within a project by aligning costs to WBS items. Fiscal year funds required by contract or by total program can be determined from the applicable matrix. Data obtained from this procedure can be used to estimate requirements for the Five Year Defense Plan, justify the fiscal year budget, or develop obligation plans (Figure 3).

The fifth element of PROMPT, Control Manuals, complements the work breakdown structure by presenting a standard package of data adoptable to any major project. The Control Manuals present, in an organized manner, the measurable plans of all major activities participating in the project, and the reports developed to monitor the progress against the plans. Separate control manuals are established for monitoring progress in specific areas of development, such as contractor effort, government effort, and integrated logistic support.

Each manual will have several objectives. One document will reveal all the essential facts of a specific area of project development. The reports will be oriented to the project management decision-making process. Data provided will be current, enabling the project manager to predict future trends. Each manual is constructed in loose-leaf form for easy updating.

Probably the most important single attribute of PROMPT is that it is a total project management system, structured around the five essential elements described in this article. In the next few years, the PROMPT Management System will be scrutinized closely as it is applied to the beginnings of two vital aircraft programs: the new supersonic F–14 fighter and the S–3 carrier-based antisubmarine warfare aircraft.

NAVAIR is confident that, with these two weapon system programs, PROMPT will be able to demonstrate clearly the benefits and effectiveness of this total project management system.

SAMSO Gets Western Test Range

An organizational change that will increase mission and geographic responsibilities of Air Force Systems Command's Space and Missile Systems Organization (SAMSO), El Segundo, Calif., has been announced by the Air Force.

The change involves the Western Test Range, Vandenberg AFB, Calif., and SAMSO's two aerospace test wings, at Vandenberg and Patrick AFB, Fla. The three will become the Space and Missile Test Center (SAMTEC), under the command of SAMSO.

Previously, the Western Test Range, which stretches from California to the Indian Ocean where it meets the Eastern Test Range, was managed as an independent unit reporting to Air Force Systems Command headquarters in Washington, D.C. With the reorganization, SAMSO becomes responsible for operating the range where many of SAMSO's flight tests are conducted.

Major General Clifford J. Kronauer, who commanded the Western Test Range, will remain as commander of SAMTEC, with headquarters at Vandenberg. Responsibilities include range engineering and support activities, and direction of SAMTEC launch operations at both Vandenberg and Patrick AFB.

USAF-FAA Developing Radar Data System

A new radar processing device has been jointly developed by the Air Force Systems Command's Electronic Systems Division, L. G. Hanscom Field, Mass., and the Federal Aviation Administration (FAA). Known as a common digitizer, the new equipment will replace present radar signal processors used by DOD. The common digitizer will allow the Air Force and FAA to share radar information for FAA air traffic control and for military air defense.

The new system will relay radar information over telephone lines for both the Air Force and FAA.

Contractor for the common digitizer equipment is the Defense and Space Group, Burroughs Corp.

Analysis and Evaluation of Proposed Army Investments

Lieutenant Colonel John M. Brown, USA

Lieutenant Peyton L. Wynns, USA

Considerable attention has been given during recent years to the use of analytical techniques in the allocation of government resources, particularly to military hardware. Although the Bureau of Reclamation and Corps of Engineers began estimating costs and benefits in the 1930s, not until the late 1950s and early 1960s was economic analysis applied to government investments on a much broader basis.

As economic analysis program was formalized in the Defense Department with the publication of DOD Instruction 7041.3, "Economic Analysis of Proposed Department of Defense Investments," in December 1966. The Department of the Army published Army Regulation 37–13, "Investment for Savings—Economic Analysis of Proposed Army Investments," in April 1967. This regulation required that an economic analysis accompany each command and agency submission to Headquarters, Department of the Army, where the sole or primary justification for investment was economic and the cost was over $200,000. Its objective was to:

- Systematically identify and portray the economic costs and savings associated with each proposal, so that meaningful comparisons of alternative choices could be made.
- Highlight key variables and assumptions on which the economic analysis was based, and evaluate these assumptions in light of past experience and expected results.
- Analyze and evaluate proposed Army investments designed to achieve economy of operations.

Economic analysis was required for such decisions as the acquisition of automatic data processing equipment, consolidation projects for warehouses and depots, and modernization projects to improve work flow or increase capacity. The major emphasis in the investment for savings program was use of the present value (or discounting) technique. In this approach, estimates for alternate projects were evaluated not only with regard to the total costs involved, but also with regard to contemporary financial requirements.

Recognizing the need for renewed emphasis on systematic analysis, the Office of the Secretary of Defense issued a revised DOD Instruction 7041.3 in early 1969. The revised instruction substantially broadened the range of problems on which analysis would be applied.

In June 1969, a new Army Regulation 37–13, "Economic Analysis of Proposed Army Investments," was published. The term "investment" is used in a broad sense. The new regulation formally extends the requirement for systematic analysis into such fields as research projects and weapon systems.

The Army has long recognized the need for using sound analytical techniques in determining requirements and fully supports the underlying concepts of economic analysis. These techniques are sometimes referred to as cost benefit analysis, cost effectiveness analysis, tradeoff analysis, cost comparisons, systems analysis, etc.

There are major opportunities for making capital improvements within the Army, which can result in a net reduction in annual operating costs or, equally important, increased efficiency within available resources. Benefits from high quality systematic analysis will include increased readiness and better working conditions for both military and civilian personnel. Through automation, consolidation, and modernization of routine operations in support areas such as facilities and processing equipment, it will be possible to increase efficiency and accomplish much more within available resources. As in business, some Army proposals are well known and relatively easy to develop and justify. The identification and justification of others will require detailed study and careful, logical analysis.

Regulation 37–13

The Office, Comptroller of the Army, has overall Department of the Army staff responsibility for implementation of economic analysis and is the proponent for Army Regulation 37–13.

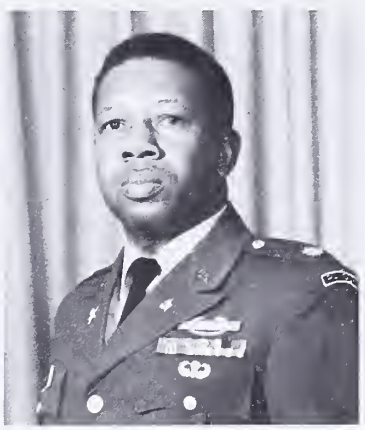
Because economic analysis cannot be separated from the benefits derived, close coordination is requred between the offices preparing economic analyses and systems-oriented organizations. Detailed coordination is, therefore, necessary with staff agencies responsible for the various aspects of research, development, procurement, and operation of Army equipment and forces. Accordingly, Army Regulation 37–13 provides only policy and general guidance, and procedures for preparation and use of economic analysis. Department of the

Army staff agencies and major Army field commands are responsible for providing more specific guidelines appropriate to their missions and functional organizational elements.

In viewing the application of economic analysis within the Army, several major characteristics stand out.

It was important that economic analysis be integrated into the existing decision process. Therefore, economic analysis has been applied within the framework of the existing Planning - Programming - Budgeting System. It is anticipated that economic analysis will have greatest utility in the planning and programming stages. At these stages, it serves as an aid in determining which projects should be undertaken. At the budget stage, when deciding how to support previously approved decisions, economic analysis has more limited application.

As a tool for decision makers, the value of economic analysis lies in its systematic approach to the consideration of alternatives rather than in mere quantification. Although it is necessary to estimate costs and benefits (inputs and outputs), a great deal of sound analysis can be performed without a knowledge of complicated techniques.



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Economic analysis is most useful when prepared by the people involved in operations and reviewed by the personnel having a primary interest in the project. In the field, economic analysis assists in identifying, supporting, and documenting program requirements. At the staff level, economic analysis provides a better basis for evaluating program proposals submitted within functional areas of responsibility.

Every defense manager has a commitment to ensure the effective utilization of resources. While economic factors are not the only considerations in selecting among alternatives, they are, however, important. Just as in the business community, Army investments made with the expectation of receiving certain benefits over an extended period of time should provide a return on investment. When funds cannot be made available for all requirements, those proposals that are approved must be those which provide the greatest overall benefits or utility.

Application

The Army approach to economic analysis program, is to:

- Determine methods of using economic analysis within the current structure of the Army Management System, with existing information systems and within current Army resources.
- Develop applicable methodology and analytical techniques in a form that can be used by an Army installation without extensive retraining of personnel. The methodology will be based on analytical techniques falling within the operations research/systems analysis area.
- Provide education and training in economic analysis to upgrade the skills of analysts. It is essential that personnel at all management and decision-making levels have an understanding of how systematic analysis can be useful in identification and justification of requirements.

Emphasis is being given to systematic analysis on spending proposals at the departmental level, as well as at lower command echelons of the Army. Steps taken by the Army Material Command (AMC) to establish an economic analysis program illustrate this emphasis.

From the start, AMC's thrust has been to emphasize the utility of economic analysis as a decision tool within the framework of the existing Planning-Programming-Budgeting System. First, AMC made a review to determine those areas which would provide the greatest immediate return. High priority was assigned to the area of military construction. Construction programs appeared tailor-made for the analytical approach called for in the economic analysis effort.

Examples of construction projects for which economic analyses have been prepared include:

- Whether to refurbish existing barracks for enlisted personnel, or to replace them with new construction.
- Whether to build a controlled environment facility for storing batteries and increasing shelf life, or to continue storage in open warehouses and experience deterioration.
- Whether to modernize depot maintenance facilities to meet expanded Army-wide requirements, or to meet them through contract, or merely to defer maintenance and extend the maintenance cycle.
- Whether to convert manually operated coal-fired boilers to automatic controlled oil-fired boilers, or to continue as is and incur high fuel, handling, and operating costs.

The Continental Army Command has applied economic analysis to purchases of data processing equipment and evaluation of fuel conversion projects. The Military Traffic Management and Terminal Service has used economic analysis to study conversion of port facilities to handle containerized freight and the economic feasibility of routing military cargo through Great Lakes ports.

Extensive monitoring of the economic analysis effort ensures that, for the first time, economic analyses will be performed on each applicable proposal before the requirement is approved and included in submissions to Headquarters, Department of the Army.

A program change request (PCR) is the vehicle by which the Service

Secretaries request changes to elements of the Five Year Defense Program. AMC headquarters has been deeply involved in initiating PCRs and in providing input to PCRs developed by Department of the Army headquarters. Economic analysis is now applied to both functional and commodity-oriented PCRs initiated by the Army, with the parameters prescribed by DOD Instruction 7041.3.

Commodity-oriented PCRs require economic analyses mainly to identify cost minimization or effectiveness maximization possibilities. Functionally oriented PCRs need economic analysis mainly to identify tradeoffs and/or cost reduction or cost avoidance considerations.

Qualitatively, the economic analysis of PCRs has had a very positive impact. Cost models (statistical and otherwise) have replaced empirical estimates. Documentation of data estimates has been greatly improved to include detailed analysis of the rationale, methodology, and computation behind these data estimates.

AMC is making use of economic analysis in other investment areas, *e.g.*, production base support, and re search and development facilities.

Other major Army field commands are aggressively improving their systematic analyses.

Upgrading Analytical Skills

Since the input to the economic analysis will most often be based on a cost estimate or cost study, the skills of the cost estimator or analyst are vital. The Army recognizes that if the quality and accuracy of cost estimates are to be improved, the skills of cost analysts need upgrading.

Because of the widespread and growing use of economic analysis, there is increased attention being given to this technique in the Army education program. An extensive portion of the Army Weapon System Acquisition Improvement Program is aimed at upgrading the expertise of analysts involved in determining weapon requirements. Army-wide, some examples of the current educational effort are courses related to economic analysis taught at the:

- Army Management Engineering Training Agency.
- Army Management School.
- Army Finance School.

In addition, briefings on the subject have been given, in the field and at Department of the Army headquarters, to broaden the understanding of involved Army personnel before establishing economic analysis efforts in various segments of the Army.

Contact with the academic community, other government agencies and especially, with the Office of the Secretary of Defense and the other military services will continue. This will produce a fruitful exchange of information.

Another effort is the preparation of a handbook on economic analysis by AMC. Research currently being conducted by Headquarters, Department of the Army, and research previously accomplished by AMC will play an integral role in the preparation of the handbook.

Areas of Emphasis

If economic analysis is to be used as widely as is anticipated, several areas appear to need considerable attention.

When mixes of systems over a period of time are studied, various systems may be phased in or out during that interval. These system composition fluctuations give rise to serious problems in costing applications and, thus, to discounting procedures. Evaluation of the following parameters would alleviate this problem:

- Economic (or useful) life of each system.
- Terminal value of each of those systems that reach the end of their economic lives during the given period of study.
- Residual value of each of those systems that have not attained the end of their economic lives at the conclusion of the given period of stud .

Studies on this aspect of economic analysis are now in progress at Headquarters, AMC, and Headquarters, Department of the Army.

Another foreseeable problem is in the area of present value analysis (discounting). The present value method of investment analysis requires a use of specific rate of return. Such a rate may be established either by policy decision or as a result of a systematic investigation of the value of capital. Currently, the DOD specified rate of return is 10 percent.

Possible alternatives to the fixed 10-percent rate for all types of investments are rates of return for broad categories of investment. For example, in the Army, these categories could be:

- Weapon systems and related support systems.
- Installation projects.
- Social overhead (Corps of Engineers Civil Works Program).

The rate of return on weapon systems should reflect the high degree of uncertainty involved in selection of useful systems capable of responding to enemy threats of varying proportions. The rate of return on Army installation projects should approach the industrial rate of return for similar activities. The social overhead rate of return might be directly related to the government interest rate.

The Army is now more determined than ever to assure that its expenditures are economically justified. Whether the economic problem is viewed as achieving a maximum level of effectiveness for a certain level of expenditures, or attaining some stated level of effectiveness at the minimum cost, the current environment emphasizes the need to achieve a maximum output for every dollar expended in the defense sector.

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Fuzes— Brains of Munitions

Lieutenant Colonel Peter E. Hexner, USA

Most modern weapon systems have as their main mission the delivery of an explosive to the enemy. In order to do this efficiently, the warheads of such systems, whether intercontinental ballistic missiles, antiballistic missiles, artillery projectiles, or grenades, must be detonated at some well defined point in space or time.

The component of the warhead which causes functioning at that optimum point, and thus determines the effectiveness of the total weapon system, is the fuze. Fuzes are aptly called the "brains of munitions." They have the unique capability to sense the proper condition for functioning. They determine position relative to the target, and cause warhead function.

In many cases, target damage caused by a weapon system is increased the closer the warhead is detonated to the intended target. Intuitively, the warhead should be in contact with the target at time of detonation. Unfortunately, for the wide class of weapon systems using high explosives, the cost of making every projectile hit the intended target is prohibitive. In fact, present technology precludes design of an air defense system, an aircraft armament system, or an artillery system which can guarantee direct hits, even if cost is ignored.

In the case of air-to-ground and ground-to-ground munitions, system efficiency is increased when the warhead detonates in proximity to the target. It turns out that in engaging personnel, or "soft" targets, maximum effectiveness is achieved when the high explosive warhead is detonated above the target. In engaging "hard" targets, such as tanks or armored personnel carriers, damage is maximized with certain munitions if the high explosive is detonated at some optimum distance away from the target. Even with nuclear munitions, fallout criteria, along with consideration of cost and effectiveness, make it desirable to detonate the warhead at some altitude above the surface.

Attempts at air defense systems which depend upon direct hits for effectiveness have been notoriously costly. For example, during World War II, the Navy fired nearly 4,000 rounds per direct hit on aircraft targets, even after automatic fire control equipment was used. While advances in radar guidance have generally kept pace with the sophistication of targets, they still have not overcome the high cost of ammunition if direct hits are required for mission success.

To reduce the extremely high cost of engaging air targets, a fuze was developed in World War II which sensed its position relative to the target. It was called the "funny fuze" by General George Patton. It is now known as the "proximity" or the "radar" fuze.

Proximity fuzes have progressed a long way since World War II when they depended on vacuum tubes for the electronic circuits. While they were originally considered to be rather esoteric devices, reserved for special situations due to their high cost and security classification, modern technology has made them cost effective over practically the complete spectrum of munitions from small 20mm projectiles up to the largest nuclear weapons. In fact, proximity fuzing has proven to be the best way to increase effectiveness of high explosive munitions for many targets, whether the cost be measured in dollars or tonnage.

This achievement did not develop by accident. It developed through good research, development and engineering by the Defense Department and private industry.

The Army Materiel Command's Harry Diamond Laboratories (HDL), located in Washington, D.C., have the prime responsibility for research in proximity fuzing techniques and for the development and engineering of fuzes for tactical use. In performing this mission, the Harry Diamond Laboratories provide the Army, as well as the Navy and the Air Force, a complete and in-depth capability in electronic fuzing.

Fuze Design Factors

When designing a fuze, several factors are considered: accuracy, reliability, safety and environmental hardness. These factors directly influence system effectiveness, producibility, storage life, and materials cost which, in turn, influence overall system cost.

The relative importance of each factor varies with the nature of the conflict and the warhead. During World War II, the increase in effectiveness gained by using proximity fuzes was so pronounced that production was initiated when one out of two research and development proto-

types functioned properly. Now that the nation is not engaged in a struggle for survival, the reliability standards are much higher, namely, proper function in at least 98 percent of the rounds.

In a similar vein, warheads vary in design and size. Some are quite large, requiring less absolute target resolution; others are small and require rather good resolution. Thus, not only do weapon designs change, but the criteria for satisfactory performance change and the relative importance of the factors change.

Accuracy. In order for the proximity fuze to detonate the warhead near the target, it must be capable of measuring the distance between the target and the warhead, comparing that distance with some predetermined value associated with the lethal radius of the warhead, and making the decision to detonate the warhead. So far, radar has proved to be the most effective means for measuring distance. With the advent of lasers and light emitting diodes, optical systems are being investigated. Sometimes they offer even better distance and direction resolution than radar systems.

Reliability and Safety. The factors of reliability and safety are obvious considerations in munitions design. The difficult part in fuze research and development is to design systems which are not only safe when handled and fired, but function reliably in the target area.

Environmental Hardness. Today's fuzes must survive a variety of severe environments. The classical tests of shaking, dropping, freezing, heating, and spraying salt water are still used. In addition, there are requirements for surviving severe accelerations imparted by artillery weapons, re-entry into the atmosphere, or the environment created by a nuclear weapon detonation.

All of these create special design problems and require broad research in materials and techniques. For example, the artillery environment imposes axial accelerations of 20,000 times the acceleration of gravity and higher, and rotation up to 350 revolutions per second. Re-entry vehicle fuzes must not only survive, but also function properly during deceleration and heating as they come back into the atmosphere. Nuclear weapons produce pronounced effects on electronic materials due to high fluxes of neutrons and x-rays. Introduction of new materials, components, and more stringent requirements makes environmental hardness an area requiring much further research.

Storage Life. Modern munitions are expected to last for extended periods of time with little or no maintenance in storage, and to function properly upon activation. Current goals are munitions which can remain in stockpile for 15 to 20 years and function perfectly upon demand.

This requires careful selection of materials and assembly techniques. It is particularly important in determining the components in fuze power supplies where chemicals, plastics, or solid state materials may change or interact in the course of time.

Producibility. It makes no sense to design a weapon system, especially one calling for high volume production, which requires unrealistic advances in the state of the art of industrial production, or requires manpower skills not readily available. Further, a design requiring high cost materials, or materials in short supply, should be avoided.

A major effort is oriented toward designing fuzes which are producible by highly automated assembly lines. As a result of continuing design effort, proximity fuzes can now be produced on an automatic assembly line.

Cost. Production and employment costs of ammunition are perhaps the most significant factors considered in fuze design. They have been the overriding factors in much of the recent research effort at Harry Diamond Laboratories. Through microcircuit technology, integrated circuits, and good industrial design, a proximity fuze is now being produced for $5 in quantity production. Such a price makes the proximity fuzing of small caliber rounds practical and will allow a significant reduction in ammunition logistics.

Research and Development at HDL

After World War II, it was recognized that proximity fuze technology was in its infancy and that it was imperative to have a military laboratory maintain an effective program in fuze research. To this end, the Harry Diamond Laboratories (originally called the Diamond Ordnance Fuze Laboratories) was constituted and assigned the mission of conducting research and development to advance the state of fuzing technology, and to apply the knowledge gained to the wide scope of military ordnance problems. To accomplish this mission and to address the fuze design factors mentioned previously, HDL has been organized to perform fuze research and development from initial concept and feasibility demonstration, through development and design for production, to management of large scale production.

The technical director of HDL is Billy M. Horton. He is assisted by five associate directors who monitor specific areas.

To accomplish its research and development mission, HDL is divided into nine technical elements plus administrative support offices. Within the nine technical elements, there are four research laboratories in which the major emphasis is on advancing the state of the art. In these laboratories new ideas or old problem areas are explored, and new systems and components are investigated and produced for use in future generation

Lieutenant Colonel Peter E. Hexner, USA, was Commanding Officer of the Harry Diamond Laboratories at the time this article was written. Prior to his assignment to HDL, he served as Military Assistant in the Office of the Secretary of Defense. Colonel Hexner is a graduate of the Industrial College of the Armed Forces and holds a Ph.D. in physics from the University of Virginia.

devices. Working closely with the research laboratories are three development laboratories in which the major emphasis is directed toward incorporating newly developed systems and components into specific warhead fuze designs. The development laboratories translate state-of-the-art technology into detailed systems designs which meet the military requirements.

Concurrent with the design effort to meet technical requirements, the HDL Engineering Division reviews the design for production and coordinates with industry to establish production techniques necessary for large volume, low cost production. The ninth technical element of HDL is the Research and Engineering Support Division which provides necessary support for prototype model fabrication and environmental testing of new hardware items.

To adequately consider fuze design factors, HDL conducts research in many diverse areas. Radio proximity fuzing is based upon radar system techniques and components. As a result of HDL's intensive research in radar fuzing, including electronic warfare techniques, significant advances are being made not only in fuzing, but in personnel detection, air defense and counter battery radars. Need for specialized electronic components requires research in solid state physics, semiconductors, microwave components, integrated circuits, and antenna structures. Interest in optical ranging systems has led to extensive research in infrared systems, light scattering and attenuation phenomena, and in lasers and laser materials. Fluidic technology, which was originated at HDL, is investigated for fuzing applications, process controls medical devices, and weapon systems directional controls.

Environmental considerations have led to development of simulation techniques for the typical artillery tube environment of high acceleration and spin. Considerations of the nuclear radiation environment have led into extensive radiation damage studies. Also, HDL is presently conducting investigations into transient radiation effects on electronics (TREE) for the Army and other services.

Role of Industry

HDL's task of design, development and production of fuzes requires substantial support from industry. Industry is called upon to develop new materials (plastics, metals, semiconductors, etc.), new components (rf sources, power supplies, etc.), and new fabrication techniques to reduce labor costs. Without active and continuing participation by industry in all phases of fuze work, HDL could not effectively accomplish its job.

A significant contribution from industry is development of techniques for highly automated production of complex electronic devices. Such a capability has just recently been initiated with the XM596 fuze program. This is the $5 fuze, previously mentioned, used on 40mm projectiles fired by armed helicopters. It is a high volume production item whose low cost depends upon modern industrial facilities capable of automatic assembly. One of industry's contributions has been and will continue to be the design and operation of facilities for such automated production.

Future Trends

While it might seem that the XM596 approaches the epitome of fuze design from a cost effectiveness standpoint, it really is just a hint of what can be done. The techniques must be applied to the whole class of antipersonnel, antitank and antiaircraft fuzing which modern warfare demands. Continued emphasis on integrated circuits and microcircuit technology, along with automatic assembly techniques, will be necessary to push fuze costs even lower.

Increasing availability of solid state optical devices makes it possible to consider the development of direction sensitive fuzes. This will enable the fuze to not only sense distance but also direction to the target. Coupled to a suitably designed aimable warhead, such fuzes could prove to be extremely effective. The major current problems are high cost and limited power capabilities of light sources.

Another area of immediate interest is multiuse and multifunction fuzes. It would be desirable to develop a fuze for a wide class of projectiles (multiuse) and incorporate into it not only a proximity function but time and impact functions. Such a fuze would decrease costs, obtain the advantage of very large volume production, reduce logistic requirements, training, and all factors that come into the use of munitions. Besides the obvious savings in production, fuze function could be literally dialled by a gunner or specified by an automatic fire control system.

Finally, an area which is basic to all fuzes is the development of power sources. New methods are required for converting mechanical, aerodynamic, chemical, or even nuclear energy into usable fuze power.

It is to these and a myriad of other problems that the Harry Diamond Laboratories will devote its resources so that the "brains of munitions" will become smarter and cost less.

USAF Using Laser in Wind Tunnel Tests

Predicting shapes for future jet aircraft capable of speeds six times the speed of sound—about 4,000 miles per hour—requires an understanding of the airflow around the aircraft. The Air Force's Arnold Engineering Development Center (AEDC), Arnold AFS, Tenn., is using a laser light source to see a cross sectional view of an aircraft model's entire air flow.

One major change is made from previous visualization techniques. Instead of heating the air before it enters the high speed wind tunnel, the air is left cool. Inside the tunnel, water vapor in the air condenses to form a fog-like condition.

A continuous wave ruby laser is then beamed through a vertical slit, and across the test section, creating a curtain of light illuminating the liquified water vapor, as car headlights illuminate fog.

Swivel mounted, the laser can scan the model from nose to tail. Changes in airflow around the model produces contrasting patterns of the shock wave and other turbulent air flow. A camera aimed through a window on the other side of the tunnel scans the model along with the laser to record the illuminated pattern of the shock wave.

Tests are being conducted for the Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio, by technicians of ARO, Inc., contract operator of AEDC.

DEFENSE PROCUREMENT

Contracts of $1,000,000 and over awarded during the month of April 1970.

DEFENSE SUPPLY AGENCY

2—**Drexel Dynamics Corp.**, Horsham, Pa. $1,585,484. 268 electric fork lift trucks. 4,000-pound capacity. Defense General Supply Center, Richmond, Va. DSA 409–70–C–4610.

20—The Defense Fuel Supply Center, Alexandria, Va., issued the following contracts for fuel oil and gasoline:
Gulf Oil Co., Houston, Tex. $2,233,475. DSA 600–70–D–1427.
Atlantic Richfield Co., Chicago, Ill. $3,035,162. DSA 600–70–D–1359.
APCO Oil Co., Oklahoma City, Okla. $1,195,723. DSA 600–70–D–1357.

24—**Texaco Inc.**, Long Island City, N.Y. $1,131,169. Fuel oil and gasoline. Defense Fuel Supply Center, Alexandria, Va. DSA 600–70–D–1451.

28—**American Oil Co.**, Chicago, Ill. $1,353,831. Gasoline and fuel oil. Defense Fuel Supply Center, Alexandria, Va. DSA 600–70–D–1356.

DEPARTMENT OF THE ARMY

1—**McGinnes Brothers, Inc.**, Houston, Tex. $2,199,510. Construction of the Catahoula Lake Diversion gated control structure, Ouachita and Black Rivers, Arkansas and Louisiana Project. LaSalle Parish, La. Army Engineer District, Vicksburg, Miss. DA–CW38–70–C–0108.

2—The Army Ammunition Procurement and Supply Agency, Joliet, Ill., issued the following contracts for metal parts for fuzes:
KDI Precision Products, Inc., Cincinnati, Ohio. $2,334,000. M427. DA–AA09–70–C–0343.
General Time Corp., LaSalle, Ill. $1,557,360. M423. DA–AA09–70–C–0342.
Gibbs Manufacturing and Research Corp., Janesville, Wis. $1,585,500. M423. DA–AA09–70–C–0341.
Hamilton Watch Co., Lancaster, Pa. $1,486,800. M423. DA–AA09–70–C–0340.
AVCO Corp., Richmond, Ind. $2,846,250. M423 and M427. DA–AA09–70–C–0339.

3—**C. R. Frederick, Inc.**, Novato, Calif. $1,459,900. Construction of a 2,200-foot concrete channel, Walnut Creek Channel Improvement Project, Contra Costa County, Calif. Army Engineer District, Sacramento, Calif. DA–CW05–70–C–0080.

—**H/R Products, Inc.**, South Bend, Ind. $1,114,632. Type G lifting plugs for 155mm, 175mm and 8-inch projectiles. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA–AA09–70–C–0344.

—**Thiokol Chemical Corp.**, Woodhine, Ga. $1,024,500. CS–XM15 riot control agent cluster canisters. Edgewood Arsenal, Md. DA–AA15–70–C–0368.

—**General Dynamics Corp.**, San Diego, Calif. $2,455,092. Prototype models of a classified sensing agent. Procurement Div., Army Electronics Command, Fort Monmouth, N.J. DA–AB07–70–C–0198.

—**Philco-Ford Corp.**, Philadelphia, Pa. $1,579,760. Engineering, fabricating and installing a Foresight Sierra Communication System, plus literature, tools and test equipment. Philadelphia and Fort Washington, Pa. Army Electronics Command, Fort Monmouth, N.J. DA–AB07–70–C–0007.

6—**Control Data Corp.**, Bethesda, Md. $1,191,412 (contract modification). Leased portion of the Tactical Operations Systems, Hq., USAREUR, Heidelhurg, Germany. Procurement Div., Army Electronics Command, Washington, D.C. DA–AB09–67–C–0014.

7—**Dravo Corp., S. J. Groves and Sons, Inc., C. H. Leavell, Fischbach and Moore, N. A. Degerstrom and Max J. Kuney Co.**, (joint venture) Bellevue, Wash. $17,497,963. Construction work and installation of equipment for the powerhouse, Dworkshak Reservoir Project, Clearwater County, Idaho. Army Engineer District, Walla Walla, Wash. DA–CW68–70–C–0079.

8—**Rone Plow Co.**, Cedartown, Ga. $1,554,348. 208 hydraulic tree dozers, size 2. Army Mobility Equipment Command, St. Louis, Mo. DA–AK01–70–C–6337.

—**Bell Helicopter Co.**, Amarillo, Tex. $1,686,554. Repair of AH–1G crash-damaged aircraft. $2,911,021. Repair of UH–1 series crash damaged aircraft. Army Aviation Systems Command, St. Louis, Mo. DA–AJ01–68–D–0056.

—**Batesville Manufacturing Co.**, Batesville, Ark. $1,557,270. Metal parts for M904E2 bomb fuzes. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA–AA09–70–C–0370.

9—**General Electric Co.**, Portland, Ore. $1,184,025. Design, manufacture and installation of two 26,200 KVA generators. Schenectady, N.Y., and Snettisham Project, Alaska, Army Engineer District, Anchorage, Alaska. DA–CW85–70–C–0011.

10—**Slate-Hall**, Portland, Ore. $1,475,879. Construction of 2¾ miles of highway and viewpoint, Lost Creek Reservoir, Rogue River Project, Jackson County, Ore. Army Engineer District, Portland, Ore. DA–CW57–70–C–0107.

—**J. S. Alberici Construction Co., Inc.**, and **Associate Engineer Co.**, (joint venture) St. Louis, Mo. $3,873,827. Pollution control—water distribution plant, Army Ammunition Plant, Newport, Ind. Army Engineer District, Chicago, Ill. DA–CA23–70–C–0055.

—**Maxson Electronic Corp.**, Macon, Ga. $5,069,228. 66mm 4-round clips, XM74. Edgewood Arsenal, Md. DA–AA15–70–C–0373.

—**H. O. Boehme, Inc.**, Westbury, N.Y. $1,570,472. AN/ASN–43 gyromagnetic compass sets and ancillary items. Army Electronics Command, Fort Monmouth, N. J. DA–AG07–69–C–0024.

—**Raytheon Co.**, Andover, Mass. $1,020,000 (contract modification). Engineering services for the Improved Hawk missile system. Andover and Bedford, Mass., and White Sands Missile Range, N. M. Army Missile Command, Huntsville, Ala. DA–AH01–70–C–0195.

—The following contracts were issued by the Army Ammunition Procurement and Supply Agency, Joliet, Ill.:
Medico Industries, Inc., Wilkes-Barre, Pa. $1,489,500. Metal parts for 2.75 inch rocket warheads, M151. DA–AA09–70–C–0360.
Chamberlain Manufacturing Co., Waterloo, Iowa. $1,512,000. Metal parts for 2.75 inch rocket warheads, M151. DA–AA09–70–C–0358. $1,825,550. Metal parts for 2.75 inch rocket smoke warheads, M156. DA–AA09–70–C–0364.
Lehigh, Inc., Easton, Pa. $1,470,000. Metal parts for rocket warheads. DA–AA09–70–C–0359.
Airport Machining Corp., Martin, Tenn. $1,536,000. Metal parts for rocket warheads, M151. Union City, Tenn. DA–AA09–70–C–0357.
Bulova Watch Co., Valley Stream, N.Y. $3,508,820 (contract modification). Metal parts for 81mm point detonating fuzes, M524A6. DA–AA09–70–C–0100.

13—**Norris Industries, Inc.**, Los Angeles, Calif. $4,125,600 (contract modification). 2.75 inch rocket motor tubes. Pico Rivera, Calif. Picatinny Arsenal, N.J. DA–AA21–70–C–0244.

—**Northrop Corp.**, Anaheim, Calif. $3,437,500 (contract modification). 2.75 inch rocket warheads, WDU 4A/A. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA–AA09–70–C–0132.

14—**Colt's, Inc.**, Hartford, Conn. $1,290,678 (contract modification). 5.56mm rifles, M16A1. Army Weapons Command, Rock Island, Ill. DA–AF03–70–C–0001.

—**Sylvania Electronic Systems Inc.**, Mountain View, Calif. $1,300,000 (contract modification). Classified study. Army Security Agency, Vint Hill Farms, Va. DA–HC07–69–C–0247.

15—**IBM Corp.**, White Plains, N.Y. $3,000,000. Classified electronics. San Jose, Calif. Army Electronics Command, Fort Monmouth, N.J.

—**Bell Helicopter Co.**, Fort Worth, Tex. $9,742,849. AH–1J helicopters. Army Aviation Systems Command, St. Louis, Mo. DA–AJ01–68–C–1928.

—**Eugene Luhr and Co.**, Columbia, Ill. $2,887,500. Excavating work, Kaskaskia River Navigation Project, Randolph County, Ill. Army Engineer District, St. Louis, Mo. DA–CW43–70–C–0180.

—**General Motors Corp.**, Indianapolis, Ind. $4,333,736 (contract modification). Adjustment to the engineering design test program for the Main Battle Tank, XM–803. Cleveland, Ohio, and Milwaukee, Wis. Army Tank Automotive Command, Warren, Mich. DA–20–113–AMC–08843(T).

16—**Umpqua River Navigation Div., Bohemia Lumber Co., Inc.**, Eugene, Ore. $1,094,400. Repair of the north jetty, Coos Bay, Ore. Army Engineer District, Portland, Ore. DA–CW57–70–C–0108.

—**General Motors Corp.**, Indianapolis, Ind. $2,165,545 (contract modification). Research and development and interim ad-

CONTRACT LEGEND

Contract information is listed in the following sequence: Date—Company — Value — Material or Work to be Performed—Location of Work Performed (if other than company plant) — Contracting Agency—Contract Number.

vance production engineering effort on the Main Battle Tank. Milwaukee, Wis., Cleveland, Ohio, Indianapolis, and Muskegon and Warren, Mich. Army Tank Automotive Command, Warren, Mich. DA-AE07-69-C-5272.

Calif. $2,449,000. Performance on Phase I, Controllahle Solid Rocket Program. Safeguard System Command, Huntsville, Ala. DA-HC60-70-C-0063.

—**Holloway Construction Co.**, Wixon, Mich. $6,569,456. Construction of an earth and rock filled dam and appurtenant works, Paint Creek Reservoir Project, Ohio. Army Engineer District, Huntington, W.Va. DA-CW69-70-C-0045.

17—**Cornell Laboratories**, Buffalo, N.Y. $1,-800,000 (contract modification). Terminal discrimination study. Safeguard System Command, Huntsville, Ala. DA-HC60-69-C-0109.

—**Beech Aircraft Corp.**, Wichita, Kan. $12,-327,434. RU-21E fixed wing utility aircraft. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-70-C-0518.

—**International Harvester Co.**, Southfield, Mich. $1,432,134. Maintenance and telephone maintenance trucks. Springfield, Ohio, Fort Wayne, Ind., St. Louis, Mo., and Berkeley, Calif. Army Tank Automotive Command, Warren, Mich. DA-AE07-70-C-3348.

—**Magline, Inc.**, Philadelphia, Pa. $2,275,-262. Second-year increment to three-year contract for electrical equipment shelters. Standish, Mich. Procurement Div., Army Electronics Command, Philadelphia, Pa. DA-AB05-69-C-0114.

20—**Hughes Aircraft Co.**, Culver City, Calif. $3,775,000 (contract modification). Repair parts for the TOW weapon system. El Segundo and Culver City, Calif. Army Missile Command, Huntsville, Ala. DA-AH01-70-C-0318.

—**Rogers Construction Co., and Babler Brothers**, (joint venture) Anchorage, Alaska. $1,994,282. Construction of centerline runway lighting and resurfacing of primary runway and taxiway, Elmendorf AFB, Alaska. Army Engineer District, Anchorage, Alaska. DA-CA85-70-C-0063.

21—**Western Electric Co.**, New York, N.Y. $1,-549,410. Communications system, Kwajalein Missile Range. Winston Salem, N.C. Safeguard System Command, Huntsville, Ala. DA-HC60-70-C-0057.

22—**Warren Brothers Co.**, Ashland Oil, Inc., Memphis, Tenn. $1,972,700. 200,000 squares of articulated concrete mattresses for channel improvement revetment for the Mississippi River and Tributaries Flood Control Project. West Feliciana Parish, La. Army Engineer District, New Orleans, La. DA-CW29-70-C-0200.

—**Amis Construction Co.**, Oklahoma City, Okla. $5,900,000. Embankment construction, Lake Kemp Reservoir, Wichita River, Tex. Baylor County, Tex. Army Engineer District, Tulsa, Okla. DA-CW56-70-C-0112.

23—**Hughes Aircraft Co.**, Culver City, Calif. $1,725,000. Night vision systems, AN/ASQ-132, installed in UH-1M helicopters. Army Electronics Command, Fort Monmouth, N.J. DA-AB07-69-C-0348.

24—The following contracts were issued by the Picatinny Arsenal, Dover, N.J.:

Marquardt Co., Ogden, Utah. $3,176,400 (contract modification). Nozzle and fin assemblies for 2.75 inch rockets. Clearfield, Utah. DA-AA21-70-C-0210.

FTC Corp., Denver, Colo. $2,443,500 (contract modification). 2.75 inch rocket nozzle and fin assembles. DA-AA21-70-C-0211.

Jackson Products Co., Tampa, Fla. $3,-134,700 (contract modification). 2.75 inch rocket nozzle and fin assemblies. DA-AA21-70-C-0213.

Hoffman Electronics Corp., El Monte, Calif. $2,816,250. Fin and nozzle assemblies for 2.75 inch rockets. DA-AA21-70-C-0539.

28—**Sanders Associates**, Bedford, Mass. $1,-268,778. and $4,329,785. FY 1970 pilot production engineering services and FY 1970 production engineering services for Forward Area Alerting Radar (FAAR). Army Missile Command, Huntsville, Ala. DA-AH01-70-C-0996 and DA-AH01-70-C-0997.

—**Pace Co.**, Memphis, Tenn. $2,277,626. White Star parachute illumination signals, M127A1. Picatinny Arsenal, Dover, N.J. DA-AA21-70-C-0381.

—**Gulf and Wesern Industries**, Waukesha, Wis. $3,192,050. 40mm cartridge cases, M118. Antigo and Waukesha, Wis. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-70-C-0128.

—**Ralph M. Parsons Co.**, Los Angeles, Calif. $1,396,895 (contract modification). Continuation of architect engineer services for preparation of a standard design for Safeguard missile radar sites and adaptation to the Grand Forks, N.D., site. Army Engineer Division, Huntsville, Ala. DA-CA87-68-C-0001.

29—**Olin Corp.**, East Alton, Ill. $1,304,983 (contract modification). 81mm illuminating projectiles, M301A3. Marion, Ill. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-70-C-0108.

—**Texas Instruments, Inc.**, Dallas, Tex. $1,-750,000. Classified. Dallas and Sherman, Tex. Army Mobility Equipment Research and Development Center, Fort Belvoir, Va. DA-AK02-70-C-0453.

—**Chrysler Corp.**, Sterling Heights, Mich. $1,259,293 (contract modification). Industrial plant equipment for medium tank mohilization planning, Detroit Arsenal. Army Tank Automotive Command, Warren, Mich. DA-AE07-69-C-4363.

30—The Army Ammunition Procurement and Supply Agency, Joliet, Ill., issued the following contracts:

Hercules, Inc., Wilmington, Del. $6,-786,735 (contract modification). Operation of propellant facilities, Army Ammunition Plant, Radford, Va. DA-11-173-AMC-00037(A).

Uniroyal, Inc., New York, N.Y. $3,189,-309 (contract modification). Operation of production facilities, Army Ammunition Plant, Joliet, Ill. DA-11-173-AMC-00062(A).

Harvey Aluminum Sales, Inc., Torrance, Calif. $9,135,681 (contract modification). Operation of facilities, Army Ammunition Plant, Milan, Tenn. DA-11-173-AMC-00520(A).

Olin Corp., Stamford, Conn. $5,146,297 (contract modification). Operation of Army Ammunition Plant, Baraboo, Wis. $9,965,032 (contract modification). Operation of component and propellant facilities, Army Ammunition Plant, Charlestown, Ind. DA-AA09-69-C-0014.

E. I. Dupont de Nemours and Co., Wilmington, Del. $1,064,840. 7,000,000 pounds of TNT. Barksdale, Wis. DA-AA09-70-C-0368.

National Presto Industries, Inc., Eau Claire, Wis. $6,696,800. Metal parts for 105mm high explosive projectiles, M1. DA-AA09-69-C-0028.

Heckthorn Manufacturing Co., Dyershurg, Tenn. $3,336,683. 40mm high explosive projectiles, M406. DA-AA09-70-C-0262.

Eisen Brothers, Inc., Lodi, N.J. $1,657,-096. 40mm projectiles, M406. DA-AA09-70-C-0077.

Chamberlain Manufacturing Co., Elmhurst, Ill. $13,209,150 (contract modification). Metal parts for 175mm projectiles, M437. Scranton, Pa. DA-AA09-70-C-0131.

Norris Industries, Inc., Los Angeles, Calif. $1,910,452 (contract modification). Metal parts for 105mm cartridge cases, M14B1. Army Ammunition Plant, Riverbank, Calif. DA-AA09-70-C-0167.

—**RCA**, Van Nuys, Calif. $2,195,944. Classified. Army Mobility Equipment Research and Development Center, Fort Belvoir, Va. DA-AK02-70-C-0406.

—**Koehring Co.**, Newton, Iowa. $1,277,076. Wheel mounted ditching machines. Army Mobility Equipment Command, St. Louis, Mo. DA-AK01-67-C-1477.

—**Globe Construction Co.**, Aurora, Colo. $1,-095,670. Construction of a primary substation (10,000 KVA), storage and miscellaneous buildings, trailer park, and inspection facilities, Lake City Army Ammunition Plant, Independence, Mo. Army Engineer District, Omaha, Neh. DA-CA41-70-B-0031.

DEPARTMENT OF THE NAVY

1—**Litton Systems, Inc.**, College Park, Mr. $1,322,999. AN/ALT-27 countermeasures transmitting sets and ancillary items. Naval Air Systems Command, Washington, D.C. N00019-70-C-0484.

—**Sante Fe Engineers, Inc.**, Lancaster, Calif. $2,037,400. Construction of an aircraft parking apron and air start system, Marine Corps Air Station, Yuma, Ariz. Naval Facilities Engineering Command, Washington, D.C. N62473-70-C-0101.

2—**United Aircraft Corp.**, East Hartford, Conn. $11,312,838 (contract modification). J-52-P-408 and J-52-J-8A aircraft engines. Naval Air Systems Command, Washington, D.C. N00019-70-C-0208.

—**Litton Systems, Inc.**, Melville, N.Y. $3,-407,124. Omega timing and control sets. Naval Electronic Systems Command, Washington, D.C. N00039-70-C-0533.

—**Ryan Aeronautical Co.**, San Diego, Calif. $1,285,975. Equipment for BQM-34A target drones. Naval Air Systems Command, Washington, D.C. F04606-70-A-0057.

—**Associates Plumbing Co.**, Santee, Calif. $1,244,816. Repair of fuel storage facilities, Naval Supply Center, Pearl Harhor, Oahu, Hawaii. Naval Facilities Engineering Command, Washington, D.C. N62471-70-C-0288.

3—**Johns Hopkins University**, Silver Spring, Md. $4,216,189 (contract modification). Advanced research on surface missile systems. Naval Ordnance Systems Command, Washington, D.C. NOw 62-0604-C.

—**IBM Corp.**, Owego, N.Y. $2,317,213. Spare parts for navigational and flight instruments for A-7E aircraft. Naval Aviation Supply Office, Philadelphia, Pa. N00383-70-A-4103-0001.

—**Kaman Corp.**, Bloomfield, Conn. $2,234,-480. Main rotary wing hlades for UH-2 and HH helicopters. Bloomfield and Moosup, Conn. Naval Aviation Supply Office, Philadelphia, Pa. N00383-70-A-0101-0003.

—**Singer-General Precision Inc.**, Binghampton, N.Y. $5,319,000. RF-4E weapon system trainers, 2F97. Binghampton and Sunnyvale, Calif. Naval Training Device Center, Orlando, Fla. N61339-70-C-0009.

—The Naval Air Systems Command, Washington, D.C., issued the following contracts:

PRD Electronics, Inc., Jericho, N.Y. $3,354,561 (contract modification). Versatile Avionics Shop Test (VAST) building hlocks and data transfer units. N00019-68-C-0449.

Jet Electronics and Technology, Inc., Grand Rapids, Mich. $1,397,819. Vertical reference gyro indicators. N00019-70-C-0354.

United Aircraft Corp., East Hartford, Conn. $8,739,922. TF-30-P-412 engines for the F-14A aircraft. N00019-70-C-0208.

6—**Ingalls Shipbuilding Div., Litton Industries, Inc.**, Pascagoula, Miss. $12,482,300 (contract modification). Overhaul and alteration of the USS Guardfish, SSN-612. Naval Ship Systems Command, Washington, D.C. N00024-69-C-0281.

—**Zisken Construction Co.**, Chicago, Ill. $2,-024,167. Construction of receiving barracks, Naval Training Center, Great Lakes, Ill. Naval Facilities Engineering Command, Washington, D.C. N62465-69-C-0350.

8—The Naval Air Systems Command, Washington, D.C., awarded the contract modifications:

Grumman Aerospace Corp., Bethpage, N.Y. $4,316,667. F-14A maintenance trainer. $1,100,000. Long lead time items for the FY 1971 F-14A aircraft program. N00019-69-C-0422.

McDonnell Douglas Corp., Long Beach, Calif. $2,776,000. TA–4J and A–4M aircraft. N00019–67–C–0170.

10—**FTS Corp.**, Denver, Colo. $2,878,595. Wing assemblies, Mk 1 Mod 0, Mk 4 Mod 0, and Mk 5 Mod 0, for Chapparal and Sidewinder missiles. Naval Ordnance Station, Louisville, Ky. N00197–70–C–0437.

—**Bethlehem Steel Corp.**, Terminal Island, Calif. $1,460,219. Overhaul of the USS Mispillion, AO–105. Supervisor of Shipbuilding, Conversion and Repair, Eleventh Naval District, Long Beach, Calif. N62791–70–B–0048.

—**Austin Electronics**, Roselle, N.J. $1,325,000. Submarine periscope training device, 21A39/3. Naval Training Device Center, Orlando, Fla. N61339–70–C–0210.

—**Singer-General Precision**, Silver Spring, Md. $4,990,000. Dual position, P–3C Directional Finding and Ranging (DIFAR) operator trainers, 14B. Naval Training Device Center, Orlando, Fla. N61339–69–C–0260.

13—**McDonnell Douglas Corp.**, St. Louis, Mo. $39,405,000 (contract modification). Long lead time items to support procurement of F–4E, RF–4E and F–4J aircraft for the Navy and Air Force. Naval Air Systems Command, Washington, D.C. N00019–68–C–0495.

—**Sanders Associates, Inc.**, Nashua, N.H. $1,000,000. Anti-missile integrated defense data transfer and correlation system for fleet evaluation. Naval Ship Systems Command, Washington, D.C. N00024–70–C–5460.

14—**Raytheon Co.**, North Dighton, Mass. $3,333,927. Production of signal data converters, Mk 72, Mods 0 and 1. Naval Ordnance Systems Command, Washington, D.C. N00017–70–C–2310.

—**North American Rockwell Corp.**, Columhus, Ohio. $3,000,000 (contract modification). Long lead time items for procurement of OV–10C aircraft. Naval Air Systems Command, Washington, D.C. N00019–69–C–0696.

16—**Pratt and Whitney Aircraft Div., United Aircraft Corp.**, East Hartford, Conn. $6,009,141. Spare parts to support J–52 aircraft engines, and modification kits and spare parts for TF–30–P8 engines for A–7A/B aircraft. Naval Aviation Supply Office, Philadelphia, Pa. N00383–0–69000A.

—**Northrop Corp.**, Newhury Park, Calif. $2,425,000. MQM–74A target drones. Naval Air Systems Command, Washington, D.C. N00019–70–C–0424.

—**Litton Systems, Inc.**, Woodland Hills, Calif. $1,453,173 (contract modification). Carrier Aircraft Inertial Navigation Systems (CAINS). Naval Air Systems Command, Washington, D.C. N00019–69–C–0582.

17—**Edo Corp.**, College Point, N.Y. $5,237,538. Conversion kits for Mk 82 Mod 0 underwater mines, and related production assemhlies. Naval Ordnance Systems Command, Washington, D.C. N00017–70–C–1419.

—**Bendix Corp.**, Baltimore, Md. $3,658,751. Transponder sets and mountings. Naval Air Systems Command, Washington, D.C. N00019–70–C–0471.

21—**Grumman Aerospace Corp.**, Bethpage, N.Y. $15,800,000 (contract modification). Long lead time parts and effort for A–6E aircraft. Naval Air Systems Command, Washington, D.C. N00019–69–C–0075 Mod P00012.

—**Raytheon Co.**, Lexington, Mass. $2,310,868 (contract modification). AIM–7E and AIM–7E–2 Sparrow missiles. Lowell, and Bedford, Mass., Bristol, Tenn., and Oxnard, Calif. Naval Air Systems Command, Washington, D.C. N00019–69–C–0358.

—**ITT Corp.**, Nutley, N.J. $1,180,000. Four AN/URN–20 radio sets. Naval Electronic Systems Command, Washington, D.C. N00039–70–C–2547.

22—**Westinghouse Electric Corp.**, Washington, D.C. $1,272,323 (contract modification). Launcher trainer equipment for Poseidon weapon system. N00030–69–C–0212. $2,903,425. Launcher closures for Poseidon weapon system. N00030–69–C–0105. Sunnyvale, Calif. Naval Strategic Systems Project Office, Washington, D.C.

—**Sparton Corp.**, Jackson, Mich. $3,238,537. AN/SSQ–47B sonchuoys. DeLeon Springs, Fla. Naval Air Systems Command, Washington, D.C. N00019–70–C–0465.

—**General Electric Co.**, Washington, D.C. $10,000,000. Poseidon fire control and guidance support equipment. Pittsfield, Mass. Naval Strategic Systems Project Office, Washington, D.C. N00030–70–C–0127.

23—**Sperry Rand Corp.**, Salt Lake City, Utah. $4,285,739. Guidance sections for Shrike missiles for the Navy and Air Force. Naval Air Systems Command, Washington, D.C. N00019–70–C–0472.

24—**Western Electric Co.**, New York, N.Y. $9,592,516. Engineering services for a classified project. Winston Salem, N.C. Naval Electronic Systems Command, Washington, D.C. N00039–70–C–3534.

—**Bulova Watch Co., Inc.**, Valley Stream, N.Y. $1,148,815. Proximity fuzes, VT Mk 71 Mod 11/12, Mk 72 Mod 12/13 and Mk 73 Mod 4/5. Naval Ships Parts Control Center, Mechanicshurg, Pa. N00104–70–C–A135.

27—**Raytheon Co.**, Bedford, Mass. $3,294,730 (contract modification). Guidance and control sections for Sparrow III missiles. Lowell and Bedford, Mass., Oxnard, Calif., and Bristol, Tenn. Naval Air Systems Command, Washington, D.C. N00019–68–C–0386.

—**Gibbs and Cox Corp.**, New York, N.Y. $1,770,947. Engineering design services and construction of four technical ship models of an advanced amphihious assualt landing craft. Naval Ship Systems Command, Washington, D.C. N00024–70–C–0274.

—**Curtiss-Wright Corp.**, Wood-Ridge, N.J. $1,484,490. Product support engineering services for J–65 series engines. Naval Air Systems Command, Washington, D.C. N00019–70–C–0254.

—**Lockheed Aircraft Corp.**, Sunnyvale, Calif. $1,376,652. Engineering and field engineering services for the Polaris weapon system. Naval Strategic Systems Project Office, Washington, D.C. N00030–70–C–0136.

28—**Davidson Fahricating Inc.**, Collingdale, Pa. $1,016,366. Mechanical mine sweeping gear, Mk 103 Mod 1., and component parts. Colwyn, Pa. Naval Ordnance Station, Louisville, Ky. N00197–70–C–0449.

—The Naval Air Systems Command, Washington, D.C., issued the following contracts:

LTV Aerospace Corp., Dallas, Tex. $82,500,000 (contract modification). Long lead time for Air Force A–7D aircraft. N00019–67–C–0143.

Thiokol Chemical Corp., Huntsville, Ala. $4,442,480. Rocket motors and igniters for the Navy and Army. N00019–70–C–0336.

Grumman Aerospace Corp., Bethpage, N.Y. $6,350,000. Modification of A–6A aircraft to the KA–6D configuration. Stuart, Fla., and Bethpage and Calverton, N.Y. N00019–70–C–0458.

30—**Dynell Electronics Corp.**, Melville, N.Y. $2,262,548. AN/SPS–40B radar systems and modification kits. Naval Ship Systems Command, Washington, D.C. N00024–70–C–1329.

—**Vitro Corp. of America**, Silver Spring, Md. $2,753,233. Configuration management program for a antisuhmarine warfare defense program. Naval Ordnance Systems Command, Washington, D.C. N00017–70–C–1416.

DEPARTMENT OF THE AIR FORCE

1—**General Motors Corp.**, Milwaukee, Wis. $2,187,120. Titan IIIC inertial guidance systems. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701–68–C–0065.

—**Raytheon Co.**, Burlington, Mass. $1,874,000. Supplies and services applicahle to the 440L electromagnetic system. Electronic Systems Division, AFSC, L. G. Hanscom Field, Mass.

3—**Control Data Corp.**, Minneapolis, Minn. $1,321,519. Automatic data processing equipment for Patrick AFB and Cape Kennedy AFS, Fla. Procurement Office, Air Force Eastern Test Range, Patrick AFB, Fla. F08650–70–M–K666.

—**The Boeing Co.**, Wichita, Kan. $2,700,600. Development of a prototype modification kit for B–52D/G/H aircraft. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F43601–70–C–2772.

—**Martin Marietta Corp.**, Orlando, Fla. $1,107,947. AN/GSC–24(V) multiplexer equipment. Rome Air Development Center, Griffis AFB, N.Y. F30602–70–C–0143.

—**Dynamics Corp. of America**, Long Island City, N.Y. $1,291,600. Repair and modification of mohile ground communications equipment, AN/MRC–105. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F34601–69–A–0345–0040.

6—**Cessna Aircraft Co.**, Wichita, Kan. $1,432,998. A–37B aircraft. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657–68–C–1290.

7—**North American Rockwell Corp.**, Anaheim, Calif. $42,023,426. Minuteman III post hoost propulsion suhsystems. Space and Missile Systems Organization, Los Angeles, Calif. F04701–68–C–0280.

8—**United Aircraft Corp.**, Stratford, Conn. $1,684,000. Spare parts for CH–3 and CH–53 helicopters. Warner Rohins Air Materiel Area, AFLC, Rohins AFB, Ga. F09603–70–A–0003.

—**The Boeing Co.**, Wichita, Kan. $1,193,941. Maintenance of B–52 aircraft. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F34601–69–C–3987.

9—**Lockheed Aircraft Corp.**, Marietta, Ga. $7,362,510. Spare parts for C–5A aircraft. Detachment 31, San Antonio Air Materiel Area, AFLC, Marietta, Ga. AF 33657–15053.

—**Litton Systems, Inc.**, Woodland Hills, Calif. $3,266,550. Repair of F–4 aircraft gyroscopes. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F04606–69–A–0203.

—**Control Data Corp.**, Minneapolis, Minn. $1,792,476. 12 months' estimated maintenance and leasing costs of electronic data processing equipment for the Camhridge Research Lahoratories, Bedford, Mass. Electronic Systems Division, AFSC, L. G. Hanscom Field, Mass.

10—**IBM Corp.**, Cape Canaveral, Fla. $1,395,326. Rental and maintenance of automatic data processing equipment at Patrick AFB, Fla. Air Force Eastern Test Range, AFSC, Patrick AFB, Fla. F08650–70–M–0053.

—**McDonnell Douglas Corp.**, Huntington Beach, Calif. $1,597,121 (contract modification). Research on the Advanced Ballistic Reentry System (ABRES). Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701–69–C–0141.

13—**General Dynamics Corp.**, Fort Worth, Tex. $21,657,775. F–111 aircraft. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. AF33657–13404.

14—**Control Data Corp.**, Minneapolis, Minn. $1,988,000. Rental of data processing equipment at Wright-Patterson AFB, Ohio. 2750th Air Base Wing, Wright-Patterson AFB, Ohio. F33600–70–F–6143.

15—The Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio, issued the following contracts:

General Electric Co., West Lynn, Mass. $3,432,800. J–85 turhojet engines. F33657–70–C–0229.

Hazeltine Corp., Little Neck, N.Y. $2,621,258. $7,621,258. Radar equipment for F–4D aircraft. Greenlawn, N.Y. F33657–70–C–0942.

16—**IBM Corp.**, Kingston, N.Y. $1,688,086 and $3,027,927. Purchase of leased data processing equipment. 2750th Air Base Wing, Wright-Patterson AFB, Ohio. F33600–70–F–6180 and F33600–70–F–6179.

—**Collins Radio Co.**, Cedar Rapids, Iowa. $4,086,836. Modification kits for mohile communications equipment. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F34601–70–C–2039.

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17—**Texas Instruments, Inc.**, Dallas, Tex. $21,567,321. Bomb guidance kits. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-70-C-0254.

20—**IBM Corp.**, Dayton, Ohio. $1,858,049 and $1,133,000. Rental of data processing equipment at Wright-Patterson AFB, Ohio. 2750th Air Base Wing, Wright-Patterson AFB, Ohio. F33600-70-F-6175 and F33600-70-F-6176.

22—**Sperry Rand Corp.**, Washington, D.C. $9,535,897 and $1,866,769. Automatic data processing equipment. 2750th Air Base Wing, Wright-Patterson AFB, Ohio. F33600-70-F-6354 and F33600-70-F-6355.

—**ESL, Inc.**, Sunnyvale, Calif. $1,079,581. Development and fabrication of an intelligence data collection system. Rome Air Development Center, AFSC, Griffis AFB, N.Y. F30602-70-C-0230.

—**Hercules, Inc.**, Wilmington, Del. $1,378,219 (contract modification). Stage III Minuteman II missile motors. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. AF04(694)-903.

—The Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio, issued the following contracts:

Conductron Corp., St. Charles, Mo. $6,466,371. A-7D aircraft simulators. F33657-69-C-0628.

AAI Corp., Cockeysville, Md. $1,970,000. AN/APM-307 electronic equipment for testing F-4 series aircraft fire control systems. F33657-70-C-0803.

23—The Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio, issued the following contracts:

Cornell Aeronautical Laboratories, Inc., Buffalo, N.Y. $2,400,000. Analysis of penetration aids for manned aircraft. F33615-70-C-1373.

Sylvania Electronic Systems, Inc., Needham Heights, Mass. $2,756,264 (contract modification). AN/PRC-90 portable multi-channel radios. F33657-70-C-0495-P002.

—**Lockheed Aircraft Corp.**, Marietta, Ga. $1,500,730. Spare parts for C-5A aircraft. Detachment 31, San Antonio Air Materiel Area, AFLC, Marietta, Ga. AF 33(657)15053.

24—**General Electric Co.**, Cincinnati, Ohio. $3,709,788. Spare parts for TF-39 engines for C-5A aircraft. Evendale, Ohio. San Antonio Air Materiel Area, AFLC, Kelly AFB, Tex. AF33(657)-15003.

—**Lockheed-Georgia Co.**, Marietta, Ga. $6,408,360. Spare parts for C-5A aircraft. Detachment 31, San Antonio Air Materiel Area, AFLC, Marietta, Ga. AF33 (657)-15053.

27—**Texas Instruments, Inc.**, Austin, Tex. $22,000,000. Developing and producing four segments (two sets each for the Air Force and Marine Corps) of photo interpretation equipment for evaluating aerial film. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-70-C-0052.

29—**Rand Corp.**, Santa Monica, Calif. $2,200,000. Studies and research. Air Force Office of Scientific Research, Arlington, Va. F44620-67-C-0045.

30—**Rohr Corp.**, Chula Vista, Calif. $2,633,400. C-141 aircraft exhaust cone assemblies. Warner Robins Air Materiel Area, AFLC, Robins AFB, Ga. F04606-70-A-0067.

—**Republic Electronic Industries, Inc.**, Melville, N.Y. $1,283,136. Design and fabrication of Tacan AN/ARM-135 airborne navigation equipment maintenance test set. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-70-C-1005.

—**Elder-Oilfield Inc.**, Houston, Tex. $2,537,555. Eight modular relocatable medical buildings. Merced, Calif., and Houston. Civil Engineering Center, Wright-Patterson AFB, Ohio. F33615-70-C-1606.

OFFSHORE

3—**Canadian Commercial Corp.**, Ottawa, Ontario, Canada. $1,108,582. 300,900 steel helmets. R. J. Stampings Co., Ltd., St. Anne Des Plains, Quebec, Canada. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-1596.

ESD Detachment Formed at Eglin AFB

The Air Force Systems Command's Electronic Systems Division (ESD), L. G. Hanscom Field, Mass., has established Detachment 14 at Eglin AFB, Fla. Formerly a field office, the detachment is commanded by Colonel John A. Trask.

Detachment 14 will initially participate in the testing of the Airborne Warning and Control System (AWACS). When the detachment becomes fully operational it will support all ESD programs under test at Eglin.

New System Detects Engine Fire, Overheat

An integrated computer system, which can detect fires and overheat in jet aircraft engines in one-tenth of a second, has been developed for the Air Force Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio. The original computer detection system was designed by the laboratory; Delco Radio, Kokomo, Ind., designed and built the system.

Weighing less than four pounds, the advanced computer can handle 24 sensors (ultraviolet and infrared fire detectors) and continuous element overheat detectors. It can operate in any of 5 modes and will normally handle up to 12 types of sensors simultaneously, as required. The computer has all necessary electronics to process analog signals from any available group of fire or overheat detectors, and to determine whether a fire, overheat, or failure of the system has occurred.

The detection system will be flight tested this summer by the Air Force Systems Command's Aeronautical Systems Division (ASD). It is designed to be used on any type of jet aircraft, military or civilian.

Aero Propulsion Laboratory, in cooperation with ASD's Deputy for Engineering, will prepare specifications for the system so that it may be bought "off the shelf." Terry Trumble is the laboratory's project manager for the system.

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New Target Missile Sought by Army

A variable speed training target (VSTT) for air defense weapons and guided missiles has been approved for development by the Army. Requirements for the target system, which may eventually replace all subsonic guided missile systems now in the Army inventory, were prepared by the Army Combat Developments Command, Fort Belvoir, Va.

The system is to combine low cost, simplicity, reliability, and transportability. Performance-wise, the VSTT would be capable of simulating a subsonic airborne threat, in support of Redeye missile, 40mm and quad 50 gun, Vulcan, Chapparal, Hawk and Nike firings requiring live targets. It will provide worldwide training targets for air defense guns and missile systems in any geographic or environmental location from the arctic to the tropics.

Operationally, the VSTT is seen as being used in training missions requiring target missiles with variable speeds up to 500 knots, with a capability of being augmented with 115 pounds of ancillary equipment. This equipment could include infrared sources, radar echo augmentations, night lights and scoring devices, mounted either internally or externally. For over-the-water ranges, it would be equipped with a water recovery kit giving up to one-hour flotation capability.

In flight, the VSTT would perform at speeds from 250 to 500 knots without tow, and 250 to 400 knots with tow, operating at minimum altitudes. Altitude performance would range from 100 meters above the terrain to more than 12 kilometers.

The VSST is to be recoverable by means of a recovery parachute or other device, on command, or on loss of transmitter carrier tone or power.

Logistics Terms Glossary Available

An Air Force technical report, called "A Compendium of Authenticated Logistics Terms and Definitions," is available to industry. The book contains 8,300 definitions and 3,300 abbreviations compiled from 430 DOD sources.

Lieutenant Colonel Fred Gluck, USAF, Assistant Professor of Logistics Management at the Air Force Institute of Technology, Wright-Patterson AFB, Ohio, compiled the glossary.

The compendium is available for $3 per hard copy and 65¢ per microfiche copy (Order No. AD 700 006) from the Commerce Department Clearinghouse for Federal Scientific and Technical Information, Springfield, Va. 22151. Orders to the Clearinghouse must be prepaid.

Microfiche copies of the glossary are available free to users registered with the Defense Document Center, Cameron Station, Alexandria, Va. 22314. Hard copies are $3.

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